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OF TRAVELS

TO THE

EQUINOCTIAL REGIONS

OF THE

NEW CONTINENT,

DURING THE YEARS 1799—1804,

BY

ALEXANDER DE HUMBOLDT,

AND

AIMÉ BONPLAND; 10782

WITH MAPS, PLANS, &c.

WRITTEN IN FRENCH BY

ALEXANDER DE HUMBOLDT,

AND TRANSLATED INTO ENGLISH BY

HELEN MARIA WILLIAMS.

VOL. VI. PART I.

LONDON :

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NEW CONTINENT

DURING THE YEARS 1793—1804

ALME BONPLAND

WITH MAPS, PLANS, &c.

ALEXANDRE DE HUMBOLDT

HELEN MARIA WILLIAMS

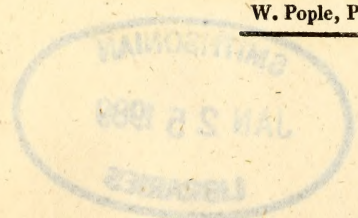
VOLUME PART I

LONDON

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(BY THE ENGLISH EDITOR.)



THE scene to which this volume chiefly relates—the Republic of Columbia—having become an object of such deep and general interest, the publishers have pleasure in at length presenting it to the public. The French original had been delayed by circumstances over which the editor had no controul. The succeeding portion, which will comprise an account of the island of Cuba, and a part of the Journey into the Cordillera of the Andes, is already in the press, and proceeding with all possible expedition. The Author having, in the course of the work, brought under his review almost all branches of the Sciences, purposes to give, at the conclusion of the whole, a classed table of contents, or methodical index, for the facility of reference.

The present volume comprehends, besides the Personal Narrative of the travellers, The History of the Nations of Carib race ; a general view of the Population of Spanish America, arranged according to difference of colour, of languages, and of religion ; a discussion of the great problem of an Oceanic Canal, or of a Water Communication between the South Sea and the Atlantic Ocean, with reference both to its utility and the obstacles which local circumstances may present to its execution ; a comparison of the more ancient Monuments of the Aboriginal Inhabitants of both Americas ; a Geological View of South America on the north of the river of the Amazons, with a general account of the ramifications of the knots of mountains which occur in the Andes from Cape Horn to the Polar Circle ; a memoir on the Horary Variations of the Barometer within the Tropics, both at the level of the ocean, and on the summit of the Cordillera of the Andes ; and a compressed view of thermometric, hygrometric, cyanometric, and electrometric observations made in the low equinoctial regions.

With this volume are given, a general map of the Republic of Columbia, drawn from the latest scientific observations and discoveries; and a map of the *Geography of the Plants of Chimborazo*, indicating the elevation at which they are respectively found.

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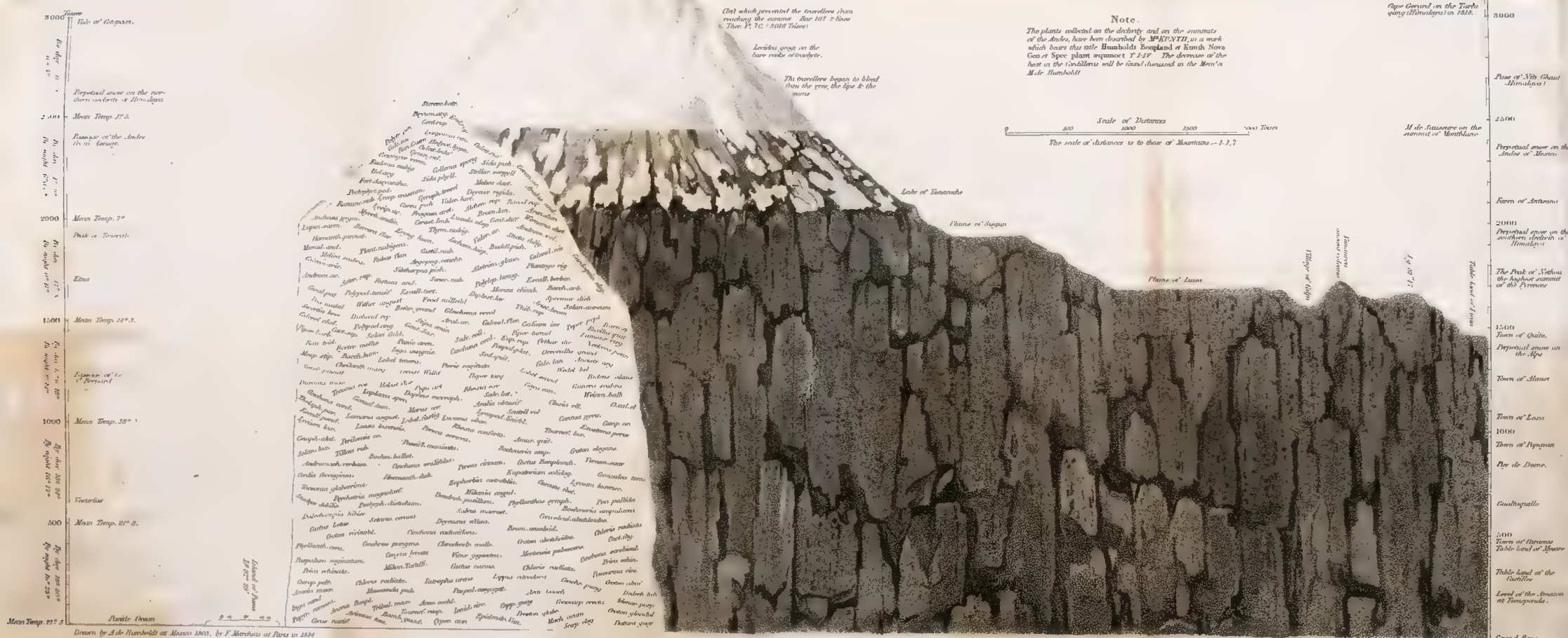
1909

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A sketch of the Geography of the Plants in the Andes of Quito, between the 0° 20' of N. Lat. and the 4° 12' of S. Lat.

A sketch of the Geography of the Plants in the Andes of Quito, between the 0° 20' of N. Lat. and the 4° 12' of S. Lat.



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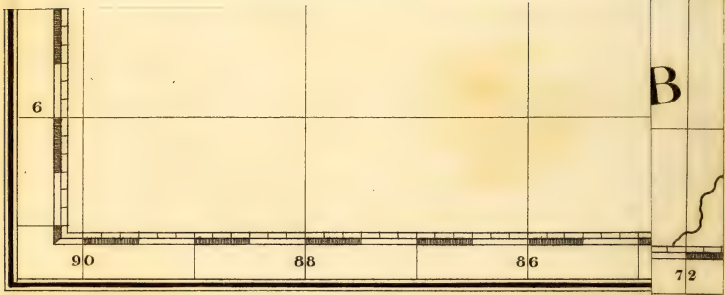




Map of
COLUMBIA,
Compiled by
A. H. BRÜE,
from the Astronomical Observations
and Topographical notices
of MR. ALEX. DE HUMBOLDT.

The Latitudes of some towns in Brazil
Towns in Brazil, situated on the East
Coast, under the name of the Brazilian
Colonies, Caramora, Caramora, and others,
in the West, have been corrected according to
the more recent observations of M. M.
Boussingault, Riviere and Roulin.

Note
Astronomical positions alone which
were determined by M. Humboldt, in order
not to confound results calculated ac-
cording to different tables & methods.
For Humboldt's & Ottomani's observations
see Vol. I. of the Atlas.



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JOURNEY
TO THE
EQUINOCTIAL REGIONS
OF
THE NEW CONTINENT.

BOOK IX.
CHAPTER XXV.

Llanos Del Pao, or the eastern part of the Plains (Llanos) of Venezuela. Missions of the Caribbees. Last abode on the coast of Nueva Barcelona, Cumana, and Araya.

It was night when we crossed for the last time the bed of the Oroonoko. We purposed to rest near the little fort of San Rafael, and the next morning at daybreak to begin our journey through the steppes of Venezuela. Nearly six weeks had elapsed since our arrival at Angostura; and we earnestly wished to reach the coast, in order to find a vessel at Cumana, or at Nueva-Barcelona, in which we might embark for the island of Cuba, and proceed thence

to Mexico. After the sufferings to which we had been exposed during several months, by sailing in small boats on rivers infested by moschetoes, the idea of a long sea-voyage had some charms for the imagination. We meant to return no more to South America. Sacrificing the Andes of Peru to the Archipelago of the Philippines, of which so little is known, we adhered to our old plan of remaining a year in New Spain, proceeding in the galleon from Acapulco to Manilla, and returning to Europe by the way of Bassora and Aleppo. It appeared to us, that, when we had once left the Spanish possessions in America, the fall of that ministry, which with noble confidence had procured us such unlimited permissions, could not be prejudicial to the execution of our enterprise. Our minds were agitated by these ideas during our monotonous journey across the steppes. Nothing enables us better to endure the little contrarieties of life, than our attention being engaged by the approaching accomplishment of a hazardous undertaking.

Our mules waited for us on the left bank of the Oroonoko. The collections of plants, and the different *geological series*, which we had brought from the Esmeralda and the Rio Negro, had greatly augmented our baggage; and, as it would have been dangerous to lose sight of our herbals, we expected to make a very slow

journey across the Llanos. The heat was excessive, on account of the reverberation of the soil, almost every where destitute of plants. The centigrade thermometer however during the day (in the shade) was only from thirty to thirty-four degrees, and at night from twenty-seven to twenty-eight degrees. Here therefore, as almost every where within the tropics, it was less the absolute degree of heat, than it's duration, that affected our organs. We were thirteen days in crossing the steppes, resting a little in the Caribbee (*Caräibes*) missions, and in the little town of Pao. I have given already* the physical picture of those immense plains, which separate the forests of Guyana from the chain of the coast. The eastern part of the Llanos, through which we passed, between Angostura and Nueva Barcelona, wears the same savage aspect as the western part, by which we came from the valleys of Aragua to San Fernando de Apure. In the season of drought, which it is here agreed to called *summer*, though the Sun is in the southern hemisphere, the breeze is felt with greater force in the steppes of Cumana, than in those of Caraccas ; because these vast plains, like the cultivated fields of Lombardy, form an inland basin, open to the east and closed on the north, south, and west,

* Vol. iv, p. 290—415.

by high chains of primitive mountains. Unfortunately, we could not avail ourselves of this refreshing breeze, of which the *Llaneros* (the inhabitants of the steppes) speak with rapture, it being the rainy season north of the equator; and though it did not rain in the steppes, the change in the declination of the Sun had long caused the action of the polar currents to cease. In those equatorial regions, where you can find your course by observing the direction of the clouds, and where the oscillations of the mercury in the barometer indicate the hour almost as well as a clock, every thing is subject to a regular and uniform type. The cessation of the breezes, the beginning of the rainy season, and the frequency of electric explosions, are phenomena, which are found to be connected by immutable laws.

At the confluence of the Apure and the Oroonoko, near the mountain of Sacuima, we had met with a French farmer, who lived amid his flocks in the most absolute seclusion*. This was the man, who in his simplicity believed, that the political revolutions of the old world, and the wars which have been the consequence, were owing solely "to the long resistance of the monks of the Observance." We had scarcely entered the Llanos of Nueva Barcelona, when

* Vol. v, p. 677.

we again found a Frenchman, at whose house we passed the first night, and who received us with the kindest hospitality. He was a native of Lyons ; had left his country at a very early age ; and appeared extremely indifferent to all that was passing beyond the Atlantic, or, as they say here, disdainfully enough for Europe, " on the other side of the great pool" (*del otro lado del charco*). Our host was employed in joining large pieces of wood by means of a kind of glue called *guayca*. This substance, used by the carpenters of Angostura, resembles the best glue extracted from the animal kingdom. It is found perfectly prepared between the bark and the alburnum of a creeper* of the family of the *combretaceæ*. It probably resembles in it's chemical properties birdlime, the vegetable principle obtained from the berries of the mistleto, and the internal bark of the holly. An astonishing abundance of this glutinous matter issues from the twining branches of the *vejuco de guayca* when they are cut. Thus, we find within the tropics a substance in a state of purity, and deposited in peculiar

* *Combretum guayca*. It might be thought, that the name of chigommier, given by botanists to the different species of combretum, has an allusion to this glutinous matter ; but the name is derived from *chigouma* (*combretum laxum*, *Aubl.*), a word of the Galibi or Caribbee language.

organs, which in the temperate zone can be procured only by the processes of art *.

We arrived on the third day at the Caribbee missions of Cari. We observed, that the ground was less cracked by the drought in this country than in the *Llanos* of Calabozo. Some showers had revived the vegetation. Small gramina, and especially those herbaceous sensitive plants, that are so useful in fattening half-wild cattle, formed a thick turf. A few fan palms (*corypha tectorum*), rhopalas† (*chaparro*), and malpighias‡ with coriaceous and glossy leaves, arose at great distances from each other. The humid spots are recognized at a distance by groups of mauritia, which are the sago-trees of those countries. Near the coast this palm-tree constitutes

* Vol. v, p. 286.

† The proteaceæ are not, like the araucaria, an exclusively southern form. (*Kotzebue, Reise*, vol. iii, p. 13.) We found the rhopala complicata, and the r. obovata, in 2° 30' and in 10° of north latitude. See our *Nov. Gen.*, vol. ii, p. 153.

‡ A neighbouring genus, *byrsonima coccollobæfolia*, b. *laurifolia* near Matagorda, and b. *ropalæfolia*. The European planters, who from the feeblest analogies believe, that they find every where the plants of their own country in the vegetation of the tropics, call the malpighia, *alcornoque* (cork-tree), no doubt on account of the *suberous* bark of the trunk. This bark contains tannin; and in another malpighia (*byrsonima moureila*), which is the febrifuge tree of Cayenne, the quinquina, or cinchonin is supposed, not without reason, to exist united with the tannin.

the whole wealth of the Guaraon Indians ; and it is somewhat remarkable, that we had found it again one hundred and sixty leagues farther south, in the midst of the forests of the Upper Oroonoko, in the savannahs that surround the granitic peak of Duida*. It was loaded at this season with enormous clusters of red fruit, resembling the cones of firs. Our monkeys were extremely fond of this fruit, which has the taste of an overripe apple. These animals, placed with our baggage on the backs of the mules, made great efforts to reach the clusters, that were suspended over their heads. The plain was undulating from the effect of the *mirage*†; and when, after travelling for an hour, we arrived at these trunks of the palm-tree, which appeared like masts in the horizon, we observed with astonishment how many things are connected with the existence of a single plant. The winds, losing their velocity when in contact with the foliage and the branches, accumulate sand around the trunk. The smell of the fruit, and the brightness of the verdure, attract from afar the birds of passage, which delight in the vibrating motion of the

* The murichi, like the sagus *Rumphii*, is a *palm-tree of the marshes* (vol. iii, p. 278 ; vol. iv, p. 334 ; vol. v, 50, 550, and 726) ; not a *palm-tree of the coast*, like the *chamærops humilis*, the common cocoa-tree, and the *lodoicea*.

† Vol. ii, p. 196 ; iv, 327.

branches of the palm-tree. A soft murmuring is heard around ; and overwhelmed by the heat, and accustomed to the melancholy silence of the steppes, we fancy we enjoy some coolness at the slightest sound of the foliage. If we examine the soil on the side opposite to the wind, we find it remains humid long after the rainy season. Insects and worms *, every where else so rare in the *Llanos*, here assemble and multiply. This one solitary and often stunted tree, which would not claim the notice of the traveller amid the forests of the Oroonoko, spreads life around it in the desert.

On the 13th of July we arrived at the village of Cari†, the first of the Caribbee missions, that are under the monks of the *Observance* of the college of Piritu‡. We lodged as usual at the *convent*, that is with the clergyman. We had, beside our passports from the captain-

* What are those worms (*loul* in Arabic), which captain Lyon, the fellow-traveller of my brave and unfortunate friend Mr. Ritchie, found in the pools of the desert of Fezzan, which served the Arabs for food, and which have the taste of *caviare* ? Are they not insects' eggs, resembling the *aguautle*, which I saw sold in the market at Mexico, and which are collected on the surface of the lakes of Texcuco ? (*Gazeta de Litteratura de Mexico*, 1794, vol. iii, No. 26, p. 201.)

† N^{ras} S^{ra} del Socorro del Cari, founded in 1761.

‡ These missionaries are called *padres misioneros Observantes del Colegio de la Purissima Concepcion de Propaganda Fide en la Nueva Barcelona*.

general of the province, recommendations from the bishops and the guardian of the missions of the Oroonoko. From the coasts of New California to Valdivia and the mouth of the Rio de la Plata, a space of two thousand leagues, every difficulty of a long journey by land may be surmounted, if the traveller enjoy the protection of the American clergy. The power which this body exercises in the state is too well established, to be soon shaken by a new order of things. Our host could scarcely comprehend, "how natives of the north of Europe could arrive at his dwelling from the frontiers of Brazil by the Rio Negro, and not by way of the coast of Cumana." He behaved to us however in the most affable manner, and showed a curiosity somewhat importunate respecting us, which the appearance of a stranger, who is not a Spaniard, always excites in South America. The minerals, which we had collected, must contain gold; the plants, dried with so much care, must be medicinal. Here, as in many parts of Europe, the sciences are thought worthy to occupy the mind only so far as they confer some solid benefit on society.

We found more than five hundred Caribbees in the village of Cari; and saw many others in the surrounding missions. It is curious to observe a nomade people, recently attached to the soil, and differing from all the other Indians in

their physical and intellectual powers. I have no where seen a taller race of men (from five feet six inches, to five feet ten inches*), and of a more colossal stature. The men, which is common in America†, are more clothed than the women. The latter wear only the *guajuco*, or *perizoma*, in the form of a band. The men have the lower part of the body as far as the hips wrapped in a piece of blue cloth, so dark as to be almost black. This drapery is so ample, that, when the temperature lowers toward the evening, the Caribbees throw it over their shoulders. Their bodies being tinged with *onoto*‡, their tall figures, of a reddish copper-colour, with their picturesque drapery, projecting from the horizon of the steppe against the sky as a back ground, resemble antique statues of bronze. The men cut their hair in a very characteristic manner; like the monks, or the children of the choir. A part of the forehead is shaved, which makes it appear extremely large. A large tuft of hair, cut in a circle, begins very near the top of the head. This resemblance of the Caribbees to the monks is not the result of living in the missions; it is not owing, as it has been errone-

* From five feet nine inches to six feet two, English, nearly.

† See above, vol. v, p. 362.

‡ *Rocou*, obtained from the *bixa orellana*. This paint is called in Caribbee *bichet*.

ously asserted, to the desire of the natives to imitate their masters, the fathers of the order of Saint Francis. The tribes, that have preserved their savage independance, between the sources of the Carony and the Rio Branco, are distinguished by the same *cerquillo de frailes*, which the first Spanish historians* at the time of the discovery of America attributed to the nations of Caribbee origin. All the men of this race, whom we saw either during our voyage on the Lower Oroonoko, or in the missions of Piritoo, differ from the other Indians not only by their tallness, but also by the regularity of their features. Their nose is not so large, and less flattened ; the cheek-bones are not so high ; and their physiognomy has less of the Mongul cast. Their eyes, darker than those of the other hordes of Guyana, denote intelligence, I had almost said the habit of reflexion. The Caribbees have a gravity in their manners, and something of sadness in their look, which is found for the most part among the primitive inhabitants of the New World. The expression of severity in their features is singularly in-

* “ Regio ab incolis Caramaira dicitur, in qua viros simul
 “ et foeminas statura aiunt pulcherrimos esse, nudos tamen,
 “ capillis aure tenus scissis mares, foeminas oblongis. A Ca-
 “ ribibus, sive Canibalibus, carniū humanarum edacibus,
 “ originem traxisse Caramairenses existimant.” *Petr. Mar-*
tyr, Ocean. (1533), p. 25. D et 26 B.

creased by the rage they have for dying their eyebrows with the juice of the caruto*, enlarging them, and joining them together. They often mark the whole face with black spots, in order to appear more savage. The magistrates of the place, the *Governador* and the *Alcades*, who alone have the privilege of carrying long canes, came to visit us. Among them were some young Indians from eighteen to twenty years of age, the choice depending solely on the will of the missionary. We were struck at finding among these Caribbees painted with arnotta the same airs of importance, the stiff mien, and the cold and disdainful manners, which are sometimes to be met with among people in office, in the old continent. The Caribbee women are less robust, and uglier than the men. On them devolves almost the whole burden of domestic labours, no well as those of the fields. They asked us with earnestness for pins; which, having no pockets, they placed under the lower lip, piercing the skin, so that the head of the pin remained within the mouth. The young girls are dyed with red; and, except the *guajuco*, are naked. Among the different nations of the two worlds the idea of nudity is altogether relative. A woman in some parts of Asia is not permitted to show the

* See vol. iv, p. 519.

end of her fingers ; while an Indian of the Caribbee race is far from considering herself as naked, when she wears a *guajuco* two inches broad. Even this band is regarded as a less essential part of dress than the pigment, which covers the skin. To go out of the hut without being painted with *arnotta*, is to transgress all the rules of Caribbean decency.

The Indians of the missions of Piritoo attracted still more our attention on account of their belonging to a nation, which by it's daring-ness, it's warlike enterprises, and it's mercantile spirit, has exerted a great influence on the vast country, that extends from the equator toward the northern coasts. We found traces every where on the Oroonoko of the hostile incursions of the Caribbees, which they pushed heretofore from the sources of the Carony and the Erevato as far as the banks of the Ventuari, the Atacavi, and the Rio Negro*. The Caribbean language is consequently the most general in this part of the world ; it has even passed (like the language of the Lenni-Lenapes, or Algonkins, and the Natchez or Muskoghees, on the west of the Alleghany mountains) to tribes which have not the same origin.

When we cast a look on that swarm of nations spread over both Americas to the east

* Vol. v, p. 204, 209, 360.

of the Cordilleras of the Andes, we fix our attention particularly on those, who, having long held the sway over their neighbours, have acted a more important part on the stage of the world. It is the object of the historian, to group facts, to distinguish masses, to ascend to the common sources of so many migrations and popular movements. Great empires, the regular organization of a sacerdotal hierarchy, and the culture which this organization favors in the first age of society, are found only on the high mountains of the west. At Mexico we see a vast monarchy enclosing small republics; at Cundinamarca and Peru, real theocracies. Fortified towns, highways and large edifices of stone, an extraordinary developement of the feudal system, the separation of casts, convents of men and women, religious congregations following a discipline more or less severe, very complicated divisions of time connected with the calendars*, zodiacs, and astrology of the enlightened nations of Asia, are phenomena, that in America belong to one region only, the long and narrow Alpine band, which extends from thirty degrees of north latitude to twenty-five degrees south. The flux of nations in the ancient world was from east to west; the Basques or Iberians, the Celts, the Germans,

* See the note *A* at the end of the ninth book.

and the Pelasgians, appeared in succession. In the New World similar migrations flowed from north to south. Among the nations that inhabit the two hemispheres, the direction of this movement followed that of the mountains ; but, in the torrid zone, the temperate table-lands of the Cordilleras exerted a greater influence on the destiny of mankind, than the mountains of Asia and central Europe. As, properly speaking, civilized nations only have a history, that of the Americans is necessarily no more than the history of a small number of the inhabitants of the mountains. A profound obscurity envelops the immense country, that stretches from the eastern slope of the Cordilleras toward the Atlantic ; and, for this very reason, whatever in this country relates to the preponderance of one nation over others, to distant migrations, to the physiognomical features which denote a foreign race, excite in us a lively interest.

Amid the plains of North America, some powerful nation, which has disappeared, had constructed circular, square, and octagonal fortifications ; walls six thousand toises in length ; tumuli from seven to eight hundred feet in diameter, and one hundred and forty feet in height, sometimes round, sometimes with several stories, and containing thousands of skeletons. These skeletons belonged to men less slender, and more squat, than the present inha-

bitants of those countries. Other bones, wrapped in fabrics resembling those of the Sandwich and Feejee islands, are found in the natural grottoes of Kentucky. What is become of those nations of Louisiana anterior to the Lenni-Lenapes, the Shawanese, and perhaps even to the Sious (Nadowesses, Narcotas) of the Missouri, who are strongly *mongolized*; and who, it is believed, according to their own traditions, came from the coast of Asia? In the plains of South America, as I have elsewhere observed, we scarcely find a few hillocks (*cerros hechos a mano*), and no where any works of fortification analogous to those of the Ohio. On a vast space of ground however, at the Lower Oroonoko as well as on the banks of the Cassiquiare and between the sources of the Essequibo and the Rio Branco, there are rocks of granite covered with symbolic figures. These sculptures denote, that the generations extinct belonged to nations different from those, which now inhabit the same regions. There seems to be no connection between the history of Mexico, and that of Cundinamarca and of Peru, at the west, on the back of the Cordilleras; but in the plains of the east a warlike and long ruling nation displays in it's features, and it's physical constitution, traces of a foreign origin. The Caribbees preserve traditions, that seem to indicate some ancient communications be-

tween the two Americas. Such a phenomenon deserves particular attention, whatever may have been the degree of barbarism and degradation, in which all the nations of the plains of the New Continent were found by the Europeans at the end of the fifteenth century. If it be true, that savages are for the most part degraded races, remnants escaped from a common shipwreck, as their languages, their cosmogonic fables, and a crowd of other indications seem to prove, it becomes doubly important to examine the paths, by which these remnants have been driven from one hemisphere to the other.

The fine nation of Caribbees now inhabits but a small part of the country, which it occupied at the time of the discovery of America. The cruelties exercised by the Europeans have made them disappear entirely from the West India islands, and the coasts of Darien; while, subjected to the government of the missions, they have formed populous villages in the provinces of New Barcelona and Spanish Guyana. I believe the Caribbees, who inhabit the Llanos of Piritoo, and the banks of the Carony and the Cuyuni, may be estimated at more than thirty-five thousand. If we add to this number the independant Caribbees, who live west of the mountains of Cayenne and Pacaraymo, between the sources of the Essequibo and the Rio Branco, we shall no doubt obtain a total

of forty thousand individuals of pure race, unmixed with any other race of natives. I dwell the more on these observations; because, previously to my travels, the Caribbees were mentioned in many geographical works as an extinct race *. Unacquainted with the interior of the Spanish colonies of the continent, these writers supposed, that the small islands of Dominica, Guadaloupe, and Saint Vincent, had been the principal abodes of this nation, of which all that remains throughout the whole of the eastern West India islands are skeletons † that are petrified, or rather enveloped in a limestone containing madrepores. According to this supposition the Caribbees must have disappeared in America, as the Guanches in the archipelago of the Canaries.

Tribes, which belong to the same people, recognise a common origin, and call themselves by the same name. That of one horde is generally

* Polit. Essay, vol. i, p. 83.

† These skeletons were discovered in 1805 by Mr. Cortez, whose interesting geological observations I have already had occasion to mention (vol. iv, p. 41, 42). They are enclosed in a formation of madrepor breccia, which the Negroes call with great simplicity the *masonry of God almighty*; and which, as recent as the *travertin* of Italy, envelopes fragments of vases and other works of man. Mr. Dauxion Lavaysse, and Dr. Kœnig, first made known in Europe this phenomenon, which has so much excited the attention of geologists. (Phil. Tr. 1814, plate 3; Cuvier, *Ossem. foss.*, vol. 1, p. lxvi.)

given to all the rest by the neighbouring nations; sometimes also the names of places become the denominations of a people, or these appellations take rise from an epithet of derision, or the fortuitous alteration of a word ill-pronounced. The name of Caribbees, which I find for the first time in a letter of Peter Martyr d'Anghiera*, is derived from Calina and Caripuna, the *l* and *p* being transformed into *r* and *b*. It is indeed very remarkable, that this name, which Columbus heard pronounced by the people of Haïti†, was found at the same time among the Caribbees of the islands and those of the continent. From the word Carina, or Calina, has been formed Galibi (Caribi); a denomination by which a tribe is known in French Guyana‡,

* *Petr. Mart. Epist. ad Pomp. Letum* (Non. Dec. 1494) *Lib. VII, No. 147, fol. xxxv*; and *Ocean., Lib. I, fol. 2, A*. According to the Caribbee pronunciation, *balana* and *parana*, the sea, are confounded together.

† *Fern. Col., Cap. 34*; in *Churchill's Coll.*, vol. 2, p. 538. *Herera, Dec. I, p. 34*.

‡ The Galibis (Calibitis), the Palicours, and the Acoquouas, have also the custom of cutting the hair in the manner of the monks; and of applying bandages to the legs of their children, in order to swell the muscles. They have the same predilection for *green stones* (saussurite), which we recognized among the Caribbee nations of the Oroonoko (vol. v, p. 383). There exist besides in French Guyana twenty Indian tribes, which are distinguished from the Galibis, though their language proves, that they have a common origin. *Barrère, France équin.*, p. 121, 239. *Lescallier, sur la Guyane*, p. 78.

of a much more diminutive stature than the inhabitants of Cari, but speaking one of the numerous dialects of the Caribbean tongue. The inhabitants of the islands are called Calinago in the language of the men; and in that of the women, Callipinan. This difference in the language of the two sexes is more striking among the people of the Caribbean race, than among other American nations (the Omaguas, the Guaranis and the Chiquitoes), where it applies only to a small number of ideas, for instance, the words mother and child. It may be conceived that women, from their separate way of life, frame particular terms, which men will not adopt. Cicero* observes, that ancient forms are best preserved by women, because their situation in society exposes them less to those vicissitudes of life (changes of place and occupation), which tend to alter the primitive purity of the language among men. But the contrast in the Caribbee nations between the dialect of the two sexes is so great, that to explain it in a satisfactory manner we must have recourse to another cause; and this may perhaps be found† in the barbarous custom, practised by those nations, of

* *Cicero, de Orat., lib. III, cap. xii, § 45, ed. Verburg.* “Facilius enim mulieres incorruptam antiquitatem conservant, quod multorum sermonis expertes ea tenent semper, quæ prima didicerunt.”

† See above, vol. v, p. 293 and 420.

killing their male prisoners, and carrying the wives of the vanquished into captivity. When the Caribbees made an irruption into the archipelago of the West India islands, they arrived there as a band of warriors, not as planters accompanied by their families. The language of the female sex was formed by degrees, as the conquerors contracted alliances with the foreign women; it was composed of new elements, words distinct from the Caribbee words*, which in the interior of the gynæceums were transmitted from generation to generation, but on which the structure, the combinations, the grammatical forms of the language of the men exerted their influence. What then took place in a small community we now find in the whole group of the nations of the New Continent. The American languages, from Hudson's bay to the straits of Magellan, are in general characterized by a total disparity of words joined with a great analogy in their structure. They are like different substances clothed in analogous forms. If we recollect, that this phenomenon comprehends one whole side of our planet, almost from pole to pole; if we consider the assimilations, that exist in the grammatical

* The following are examples of the difference between the language of the men (*m*), and the women (*w*); *isle*, oubao *m.*, acaera *w.*; *man*, ouekelli *m.*, eyeri *w.*; *but*, irhen *m.*, atica *w.*

forms (in the genders applied to the three persons of the verb, the reduplications, the frequentatives, the duals); it will appear highly astonishing, to find a uniform tendency in the developement of the understanding, and language among so considerable a portion of the human race.

We have just seen, that the dialect of the Caribbee women, in the West India islands, contained the vestiges of a language that was extinct. What was that language? Of this we are ignorant. Some writers have thought, that it might be that of the Ygueris, or primitive inhabitants of the Caribbee islands; others have perceived in it some resemblance to the ancient idiom of Cuba, or to those of the Aruacas, and the Apalachites in Florida*: but these hypotheses are all founded on a very imperfect knowledge of the idioms, which it has been attempted to compare.

In reading with attention the Spanish authors of the sixteenth century, we see, that the Caribbee nations then extended over eighteen or nineteen degrees of latitude, from the Virgin islands on the east of Portorico to the mouths of the

* *Labat, Voy.*, vol. vi, p. 129. *Rochefort*, p. 326. *Bibl. Univ.*, 1817, p. 355. Is the word *Igueris* (*Iyeris*?) a corruption of *Eyeris*, which, as we have just seen, signifies *man* in the dialect of the Caribbee women? This employment of the word *man* is very common in ethnographic names.

Amazon. Another prolongation toward the west, along the coast chain of Santa Martha and Venezuela, appears less certain. Gomara, however, and the most ancient historians, give the name of Caribana, not, as it has since been done, to the country between the sources of the Oroonoko and the mountains of French Guyana*, but to the marshy plains between the mouths of the Rio Atrato and the Rio Sinu. I have been on these coasts myself in going from the Havannah to Porto Bello; and I there learned, that the cape, which bounds the gulf of Darien or Uraba on the east, still bears the name of Punta Caribana. An opinion prevailed heretofore pretty generally, that the Caribbees of the West India islands derived their origin, and even their name, from these warlike people of Darien. “Inde Vrabam ab orientali prehendit ora, quam appellant indigenæ Caribana, unde Caribes insulares originem habere nomenque retinere dicuntur.” Thus Anghiera†

* The map of Hondius, of 1599, which accompanies the Latin edition of the narrative of Raleigh's voyage. In the Dutch edition (*Nieuwe Cuerte van het goudrycke landt Guiana*), the Llanos of Caraccas, between the mountains of Merida and the Rio Pao, bear the name of Caribana. We may remark here, what we observe so often in the history of geography, that the same denomination has spread by degrees from west to east.

† *Petr. Mart.*, Dec. 2, lib. 1, p. 26 B, Dec. 3, lib. 5, p. 54 A.

expresses himself in his *Oceaniques*. He had been told by a nephew of Amerigo Vespucci, that thence as far as the snowy mountains of Saint Martha all the natives were “ e genere Caribium, vel Canibalium.” I do not deny, that real Caribbees may have had a settlement near the gulf of Darien, and that they may have been driven thither by the easterly currents : but it may also have happened, that the Spanish navigators, little attentive to languages, called every people of a tall stature and ferocious character Caribbee and Cannibal. Still it is by no means probable, that the Caribbees of the islands and of Parima imposed on themselves the name of the region, which they had originally inhabited. On the east of the Andes, and wherever civilization has not yet penetrated, it is the people who give the name to the places where they have settled *. We have already had occasion several times to observe, that the words *Caribbees* and *Cannibals* appear significant ; that they are epithets, which allude to valour,

* These names of places can be perpetuated only where the nations succeed immediately to each other, and where the tradition is uninterrupted. Thus, in the province of Quito, many of the summits of the Andes bear names, which belong neither to the Quichua (the language of the Inca) nor to the ancient language of the Paruays, governed by the conchocando of Lican.

strength, and even superior intelligence *. It is worthy of remark, that, at the arrival of the Portuguese, the Brazilians designated their magicians by the name of *caraibes* †. We know, that the Caribbees of Parima were the most wandering people of America ; perhaps some wily individuals of that nation acted the same part, as the *Chaldeans* of the ancient continent. The names of nations are easily annexed to particular professions ; and when, in the time of the Cæsars, the superstitions of the east were introduced into Italy, the *Chaldeans* came as little from the banks of the Euphrates, as our Egyptians or Bohemians (who speak a dialect of India) came from the banks of the Nile or the Elbe.

When the continent and the neighbouring islands are peopled by the same nation, we may choose between two hypotheses ; supposing that the emigration has taken place either from the islands to the continent, or from the continent to the islands. The Iberians (Basques), who were settled at the same time in Spain and in the Mediterranean islands ‡, afford an instance of this problem ; as do also the Malays, who ap-

* Vespucci says : “ Charaibi magnæ sapientiæ viri.” *Gryn. Nov. Orb.*, p, 145. On the word cannibal, see vol. v, p. 425.

† *Laet*, p. 543.

‡ *Wilhelm von Humboldt, Urbewohner Hispaniens*, p. 167.

pear indigenous in the peninsula of Malacca, and in the district of Menangkabao in the island of Sumatra*. The archipelago of the great and little West India islands forms a narrow neck of land, broken parallel to the isthmus of Panama, and heretofore joining the peninsula of Florida to the north-east extremity of South America. It is the eastern shore of an inland sea, which may be considered as a basin with several outlets. This singular configuration of the land has served to support the different systems of migration, by which it has been attempted to explain the settlement of the nations of the Caribbean race in the islands, and on the neighbouring continent. The Caribbees of the continent admit, that the little West India islands were anciently inhabited by the Aruacas†, a warlike nation, the great body of which is still found on the shores of Surinam and Berbice. They assert, that the Aruacas, with the exception of the women, were all exterminated by some Caribbees, who came from the mouths of the Oroonoko. They cite, in support of this

* Crawford, Ind. Archipel., vol. ii, p. 371. I make use of the word indigenous, *autocthoni*, not to point out a fact of creation, which does not belong to history; but simply to indicate, that we are ignorant of the *autocthoni* having been preceded by any other people.

† *Arouaques*. The missionary Quandt (*Nachricht von Surinam*, 1807, p. 47) calls them *Arawackes*.

tradition, the traces of analogy, which are observed between the language of the Aruacas and that of the Caribbee women ; but we must recollect, that the Aruacas, although the enemies of the Caribbees, belonged to the same branch of people ; and that the same similitude exists between the Aruack and Caribbee languages, as between the Greek and the Persian, the German and the Sanscrit. According to another tradition, the Caribbees of the islands came from the south, not as conquerors, but on being expelled from Guyana by the Aruacas, who ruled originally over all the neighbouring nations. Finally, a third tradition*, which is much more general and more probable, makes the Caribbees arrive from North America, and indeed from Florida. A traveller, who has collected whatever relates to these migrations from north to south, Mr. Bristock, asserts, that a tribe of Confachites (Confachiqui) had long warred with the Apalachites ; that the latter, having yielded to that tribe the fertile district of Amana, called their new confederates Caribbes (that is *valiant strangers*) ; but that, in

* The province of Confachiqui, subject in 1541 to a woman, is become celebrated by the expedition of Hernando de Soto to Florida. (*Her. Dec. 7*, p. 21.) Among the nations of the Huron tongue, and the Attakapas, the supreme authority was also often confided to women. *Charlevoix*, vol. v, p. 397 ; *Filson*, p. 185.)

consequence of an altercation on their religious rites, the Confachite-Caribbees were driven from Florida. They went first to the Yucayas or Lucayes islands (to Cigateo and the neighbouring islands); thence to Ayay (Hayhay, now Santa Cruz), and to the little Caribbee islands; and lastly to the continent of South America *. It is believed, that this event took place toward the year 1100 of our æra; but in this estimation it is supposed, as in certain fables of the east, "that the sobriety and innocent manners of savages" augment the mean term of a generation to one hundred and eighty or two hundred years, which renders the indication of a fixed epoch altogether imaginary. In the course of this long migration, the Caribbees had not touched at the larger islands; the inhabitants of which however, believed also, that they came originally from Florida †. The islanders of Cuba, Haïti, and Boriken (Portorico), were, according to the uniform testimony of the first *conquistadores*, entirely different from the Caribbees; and at the period of the discovery of

* *Rocheport, Hist. des Antilles*, vol. i, p. 326—353; *Garcia*, p. 322; *Robertson*, Book iii, note 69. The conjecture of father Gili, that the Caribbees of the continent may have come from the islands at the time of the first conquest of the Spaniards (*Saggio*, vol. iii, p. 204), is contrary to all that the first historians relate.

† *Herera*, Dec. 1, p. 235; Dec. 2, p. 163.

America, the latter had already abandoned the group of the little Lucayes islands ; an archipelago, in which an astonishing variety of languages prevailed, as always happens in lands peopled by shipwrecks, and by fugitives*.

The dominion, which the Caribbees so long exercised over a great part of the continent, and the remembrance of their ancient greatness, have inspired them with a sentiment of dignity and national superiority, which displays itself in their manners and their discourse. "We alone are a nation," say they proverbially ; "the rest of mankind (*oquili*) are made to serve us." This contempt of the Caribbees for their ancient enemies is so strong, that I saw a child of ten years of age foam with rage on being called a *Cabre* or *Cavere* ; though he had never in his life seen an individual of this unfortunate people†, who gave their name to the town of Cabruta (Cabritu) ; and who, after a long resistance, were almost entirely exterminated by the Caribbees. Thus we find among half savage hordes, as in the most civilized part of Europe, those inveterate animosities, which have caused the names of nations, that are enemies, to pass

* "La gente de las islas Yucayas era (1492) mas blanca y de major policia que la de Cuba y Haïti. Havia mucha diversidad de lenguas." *Gomara, Hist. de Ind.*, fol. xxi.

† See above, vol. v, p. 151, 204, 209, and 681.

into their respective languages as appellations the most opprobrious.

The missionary led us into several Indian huts, where an extreme neatness and order prevailed. We saw with pain the torments, which the Caribbee mothers inflict on their infants, in order not only to enlarge the calf of the leg, but to raise the flesh in alternate stripes from the ankle to the top of the thighs. Bands of leather, or of woven cotton, are placed like narrow ligatures at two or three inches distant; and being tightened more and more, the muscles between the bands become swelled. Our infants when swaddled suffer much less than these Caribbee children, in a nation which is said to be so much nearer a state of nature. In vain the monks of the missions, without knowing the works or the name of Rousseau, attempt to oppose this ancient system of physical education. Man when just issued from the woods, and who is thought to be so simple in his manners, is far from being docile with respect to his ornaments, and the ideas which he has formed of beauty and propriety. I observed however with surprise, that the manner in which these poor children are bound, and which seems to obstruct the circulation of the blood, does not weaken their muscular movements. There is no race of men more robust, and swifter in running, than the Caribbees.

If the women labour to form the legs and thighs of their children so as to produce what the painters call undulating outlines, they abstain, at least in the Llanos, from flattening the head, by compressing it between cushions and planks from the most tender age. This usage, so common heretofore in the islands, and among several tribes of the Caribbees of Parima and French Guyana, is not practised in the missions which we visited. The men there leave the forehead rounder than the Chaymas, the Otomacks, the Macoes, the Maravitans, and the greater part of the inhabitants of the Oroonoko. A systematizer would say, that it is such as the intellectual faculties require. We were so much the more struck by this observation, as the skulls of Caribbees engraved in Europe*, in some works of anatomy, are distinguished from all other human skulls by the most depressed forehead, and the most acute facial angle. But in osteological collections the productions of art have been confounded with the state of nature. What are shown as the skulls of Caribbees of the island of Saint Vincent, "almost destitute of forehead," are skulls shaped between planks, and belonging to Zamboes (*black Carib-*

* I shall only mention as an example a plate drawn by the illustrious anatomist Peter Camper: *Viri adulti cranium ex Caraibensium insula Sancti-Vicentii in Museo Clinii asservat*, 1785.

bees), who are descended from Negroes and true Caribbees*. The barbarous habit of flattening the forehead is found among several nations †, that are not of the same race; and has been observed recently as far as in North America; but nothing is more vague than the conclusion, that some conformity of customs and manners proves an identity of origin. The traveller, who observes the spirit of order and submission, that prevails in the Caribbee missions, can scarcely

* These unhappy remains of a people heretofore powerful were banished, in 1795, to the island of Rattam, in the bay of Honduras, because they were accused by the English government of having connexions with the French. An able minister, Mr. Lescallier, had proposed (1760) to the court of Versailles, to invite the *red and black Caribbees* from Saint Vincent to Guyana, and employ them as free men in the cultivation of the land. I doubt if their number at that period amounted to six thousand; the island of Saint Vincent containing in 1787 not more than fourteen thousand inhabitants of all colours. (*Lescallier, sur la Guyane francaise*, p. 47.)

† For instance, the Tapoyranas of Guyana (*Barrere*, p. 239), the Solkeeks of Upper Louisiana (*Walckenaer, Cosmogr.*, p. 583). “Los Indios de Cumana,” says Gomara (*Hist. de Ind.*, fol. xlv), “aprietan a los niños la cabeça muy blando, pero mucho, entre dos almohadillas de algodón para ensanchar los la cara, que lo tienen por hermosura. Las donzellas van de todo punto desnudas. Traen senogiles muy apretados por debaxo y encima de las rodillas, para que los muslos y pantorillas engorden mucho. Dan las novias á los piaches, hombres sanctos y religiosos. Los reverendos padres toman aquel trabajo y los novios se quitan de sospecha, quexa y pena.”

persuade himself, that he is among cannibals. This American word, of a somewhat doubtful signification, is probably derived from the language of Haïti, or that of Portorico ; it has passed into the languages of Europe, since the end of the fifteenth century, as synonymous with that of anthropophagi. Edaces humanarum carnium novi heluones anthropophagi, Caribes alias Canibales appellati," says Anghiera, in the third decade of his *Oceanics* *, dedicated to pope Leo the tenth. I have little doubt, that the Caribbees of the islands, when a conquering people, exercised cruelties toward the Ygneris, or ancient inhabitants of the West Indies, who were weak, and little warlike ; but we must also admit, that these cruelties were exaggerated by the first travellers, who heard only the narratives of nations that were the ancient enemies of the Caribbees. It is not always the vanquished solely, who are calumniated by their contemporaries ; the insolence of the conquerors is avenged also by augmenting the list of their crimes.

We were assured by all the missionaries of the Carony, the Lower Oroonoko, and the *Llanos del Cari*, whom we had an opportunity of consulting, that the Caribbees are perhaps the least anthropophagous nations of the New Conti-

* *Dec. 3, lib. 3, p. 49, B.*

ment. They extend this assertion event to the independant hordes who wander on the east of the Esmeralda, between the sources of the Rio Branco and the Essequibo. We may conceive, that the fury and despair, with which the unhappy Caribbees defended themselves against the Spaniards, when in 1504 a royal decree* declared them slaves, may have contributed to the reputation they have acquired of ferocity. The first idea of attacking this nation, and depriving it of liberty and of it's natural rights, is owing to Christopher Columbus†, who, being a man of the fifteenth century, was not always so humane, as he is said to be in the eighteenth from hatred of his detractors. Subsequently the licenciado Rodrigo de Figueroa was appointed by the court in 1520, to decide which of the tribes of South America might be regarded as of Caribbee race, or as *cannibals*; and which were *Guatiao*‡, that is, Indians of peace, and

* “Dati erant in prædam Caribes ex diplomate regio. Missus est Johannes Poncius qui Caribum terras depopuletur et in servitutem obscoenos hominum voratores redigat.” *Petr. Mart. Ocean.*, Dec. 1, lib. p. 26, A; te Dec. 3, lib. vi, p. 57, C. Gomara, *Hist. de Ind.* fol. cxxix.

† *Pedro Muñoz, Hist. del Nuevo Mondo*, p. 199.

‡ I had some trouble in discovering the origin of this denomination, become so important from the fatal decrees of Figueroa. The Spanish historians often employ the word *guatiao* to designate a branch of nations. “La isla Margarita entre las islas de Caribes y de Indios *Guatiao*s, amigos

friends of the Castilians. That ethnographic piece, called *el auto de Figueroa*, is one of the most curious records of the barbarism of the first *conquistadores*. Never had the spirit of system served more effectually to flatter the passions. Our geographers do not distinguish more arbitrarily in central Asia the Mongul from the Tatar nations, than Figueroa traced the limit between the cannibals and the *Guatiao*s. Without any attention to the analogy of languages, every nation, that could be accused of having devoured a prisoner after a battle,

de los Castellanos, que estan mas adelante de la isla Española. En lo mas arriba de la costa de Tierra firme havia una provincia que se decia Parucuria, la qual era de *Guatiao*s que no son Caribes." *Herera*, Dec. 2, p. 258 ; Dec. 3, p. 210. Becoming a *guatiao* of any one appears to me, to have signified in the language of Haïti concluding a treaty of friendship. In the West India Islands, as well as in the archipelago of the South Sea, names were exchanged as a token of alliance. "Juan de Esquivel (1502) se hize *Guatiao* de Cacique Cotubanama ; el qual desde adelante se llamó Juan de Esquivel, porque era liga de perpetua amistad entre los Indios trocarse los nombres : y trocados quedaban *Guatiao*s, que era tanto como confederados y hermanos en armas. Ponce de Leon se hize *Guatiao* con el poderoso Cacique Agueinaha." *Herera*, Dec. 1, p. 129, 159, 181. One of the Lucayes islands, inhabited by a mild and pacific people, was heretofore called *Guatao* (Laet, p. 20) ; but we will not insist on the etymology of this word, because, as was observed above, the languages of the Lucayes islands differed from those of Haïti.

was arbitrarily declared of Caribbee race. The inhabitants of Uriapari (of the peninsula of Paria) were named Caribbees; the Urinacoes (settled on the banks of the Lower Oroonoko, or Urinucu), Guatiaos. All the tribes designated by Figueroa as Caribbees were condemned to slavery; and might at will be sold, or exterminated by war. In these bloody struggles, the Caribbee women, after the death of their husbands, defended themselves with such desperation, that, Anghiera says*, they were taken for tribes of Amazons. The odious declamations of a Dominican monk (Thomas Hortiz) contributed to prolong the misfortunes, that weighed on whole nations. However, amid the cruelties exercised toward the Caribbees, it is consoling to find, that there existed some courageous men, who caused the voice of humanity and justice to be heard. Some of the monks embraced an opinion different from that which they had at first adopted†. In an age when there could be no hopes of founding public liberty on civil institutions, an attempt was made to defend at least individual liberty. "That is a law most holy (*ley sanctissima*)," says Gomara, in 1551, "by which our emperor has prohibited the reducing of the Indians to slavery. It is just,

* *Ocean.*, Dec. 3, lib. ix, p. 63, D. See also above, vol. v, p. 394.

† Gomara, *Hist. de Ind.*, fol. xix.

that men, who are all born free, should not become the slaves of one another."

We observed with surprise, during our abode in the Caribbee missions, the facility with which young Indians of eighteen or twenty years of age, when raised to the employment of *alguacil*, or *fiscal*, harangued the municipality for whole hours. Their enunciation, the gravity of their deportment, the gestures which accompanied their speech, all denoted an intelligent people capable of a high degree of civilization. A Franciscan monk, who knew enough of the Caribbee language to preach in it occasionally, made us notice in the discourses of the Indians, how long and harmonious the periods were, without ever being confused or obscure. Particular inflexions of the verb indicate previously the nature of the object, whether it be animate or inanimate, one or many. Little annexed forms (*suffixa*) mark the gradations of sentiment; and here, as in every language formed by an unshackled development, the clearness arises from that regulating instinct *, which characterises human intelligence in the various states of barbarism and cultivation. The whole

* *William von Humboldt*, on the comparative Study of Languages, and the different Epochs of their Development, 1821 (in German), p. 13. See also, vol. iii, p. 272; and vol. v, p. 295.

village assembles on holidays before the church, after the celebration of mass. The young girls place at the feet of the missionary faggots of wood, bunches of plantains, and other provision of which he stands in need for his household. At the same time the *governador*, the *fiscal*, and other municipal officers, all of whom are Indians, exhort the natives to labour, proclaim the occupations of the ensuing week, reprimand the idle, and, since it must be told, severely cudgel the untractable. The strokes of the cane are received with the same insensibility with which they are given. These acts of distributive justice appear very long and frequent to travellers, who cross the Llanos in their way from Angostura to the coasts. It were to be wished, that the priest did not dictate these corporal punishments at the instant of quitting the altar, and that he were not in his sacerdotal habits the spectator of this chastisement of men and women; but this abuse, or, if the reader prefer the term, this want of propriety, arises from the principle on which the strange government of the missions is founded. The most arbitrary civil power is strictly connected with the rights, which the priest exerts over the little community; and, although the Caribbees are not *cannibals*, and we would wish to see them treated with mildness and indulgence, it may be conceived, that energetic measures are some-

times necessary, to maintain tranquillity in this rising society.

The difficulty of fixing the Caribbees to the soil is so much the greater, as they have been for ages in the habit of trading on the rivers. We have described above this active people, at once commercial and warlike, occupied in the traffic of slaves, and carrying merchandize from the coasts of Dutch Guyana to the basin of the Amazon. The travelling Caribbees were the Bukharians of equinoctial America ; accordingly the necessity of counting the objects of their little trade, and transmitting intelligence, had led them to extend and improve the use of the *quippoes*, or, as they call them in the missions, the *cordoncillos con nudos* *. These *quippoes* or knots are found in Canada †, in Mexico (where Boturini procured some from the Tlascaltecks), in Peru, in the plains of Guyana, in central Asia, in China, and in India. As rosaries, they are become objects of devotion in the hands of the Christians of the east ; as *swanpans*, they have been employed in the operations of manual or *palpable arithmetic* by the Chinese, the Tatars, and the Russians ‡. The independant Ca-

* Vol. v, p. 360.

† *Caulin*, p. 333.

‡ *Views of the Cordilleras, and American Monuments*, vol. i, p. 168 ; ii, p. 146. On the *quippoes* found at the Oroonoko, among the Tamanacks, see *Gili*, vol. ii, p. . The

ribbees, who inhabit the country so little known between the sources of the Oroonoko, and those of the rivers Essequibo, Carony, and Parima*, are divided into tribes; and, like the nations of the Missouri, Chili, and ancient Germany, form a political confederation. This system is the most suitable to the spirit of liberty, which prevails in those warlike hordes, who see no advantage in the ties of society but for common defence. The pride of the Caribbees leads them to withdraw themselves from every other tribe;

quippoes of strings of the nations of Upper Louisiana are called *wampum*. (*John Filson, Hist. of Kentucky, p. 102; Charlevoix, Hist. de la Nouv. France, vol. v, p. 308; Lepage de Pratz, Hist. de la Louisiana, vol. ii, p. 196.*) Anghiera relates (*Ocean., Dec. 3, lib. 10, p. 65, D.*) a very curious fact, which seems to prove, that the travelling Caribbees had some idea of bound books, like those of the Mexicans and our own. I have elsewhere made known (*Views of the Cordilleras, vol. i, p. 174.*) the curious discovery of rolls of paintings found on the banks of the Ucayale, among the Panoes. The Peruvians had also, beside the *quippoes*, hieroglyphical paintings similar to those of Mexico, but ruder. (*Garcia, Origen de los Indios, p. 91.*) Since the conquest painted pages have been used by them for confession. Perhaps the fugitive Caribbee, who came to Darien from the inland country, and of whom Anghiera makes mention, had had an opportunity of seeing at Quito, or at Cundinamarca, some Peruvian book. I employ, like the first Spanish travellers, the word *book*, since it by no means presumes the use of alphabetical writing.

* Rio Branco, or Rio de Aguas Blancas.

even from those, to whom from their language they have some relation.

They claim the same separation in the missions ; which seldom prosper, when any attempt is made, to associate them with other mixed communities, that is with villages, where every hut is inhabited by a family belonging to another nation, and speaking another idiom. The chiefs of the independant Caribbees are hereditary in the male line only, the children of sisters being excluded from the succession. This is founded on a system of mistrust, which denotes no great purity of manners ; it is the custom of India, of the Ashantees (in Africa), and among several tribes* of the

* Among the Hurons (Wiandots) and the Natchez, the succession to the magistracy is continued by the women : it is not the son who succeeds, but the son of the sister, or of the nearest relation in the female line. This mode of succession is said to be the most certain, because the supreme power remains attached to the blood of the last chief ; it is a practice that ensures legitimacy. (Filson, p. 183.) I have found ancient traces of this strange mode of succession, so common in Africa and in the East Indies, in the dynasty of the kings of the West India islands. “ In testamentis autem quam fatue sese habeant intelligamus : ex sorore prima primogenitum, si insit, relinquunt regnorum hæredem ; sin minus, ex altera, vel tertia, si ex secunda proles desit : quia a suo sanguine creatam sobolem eam certum est. Filios autem uxorū suarū pro non legitimis habent. Uxores ducunt quotquot placet. Ex uxoribus chariores cum regulo sepeliri patiuntur.” *Petr. Mart. Ocean., Dec. 3, lib. ix, p. 63, B.*

savages of North America. The young chiefs, like the youths who are desirous of marrying, are subjected to the most extraordinary fasts and penances. They are purged with the fruit of some of the euphorbiaceæ; are sweated in stoves; and take medicines prepared by the *marirris* or *Piaches*, which are called in the transalleganian countries *war-physick*. The Caribbee *marirris* are the most celebrated of all: at once priests, jugglers, and physicians, they transmit to their successors their doctrine, their artifices, and the remedies they employ. The latter are accompanied with laying on of hands, and certain gestures and mysterious practices, which appear to be connected with the most anciently known processes of animal magnetism. Although I had opportunities of seeing many persons, who had closely observed the confederated Caribbees, I could not learn whether the *marirris* belong to a particular cast. It is observed in North America, that, among the Shawanese*, divided into several tribes, the priests, who preside at the sacrifices, must be (as among the Hebrews) of one particular tribe, that of the Mequachakes. Whatever may be hereafter discovered in America respecting a

* People that came from Florida, or from the South (*shawanau*), toward the North. (*Archæol. Amer.*, vol. i, p. 275; *Histor. Trans. of Phil.*, vol. i, p. 28, 69, 77, 83).

sacerdotal cast appears to me calculated to excite great interest, on account of those priest-kings of Peru, who called themselves the children of the Sun; and of those *sun-kings* among the Natchez, who involuntarily recall to mind the Heliades of the first eastern colony of Rhodes*. In order to study thoroughly the manners and customs of the great Caribbee nation, it is requisite to visit the missions of the Llanos, those of the Carony, and the savannahs that extend to the South of the mountains of Pacaraymo. The more we learn to know them, say the monks of Saint Francis, the more we lose the prejudices, which prevail against them in Europe, as being more savage, or, to use the simple expression of a lord of Montmartin, as being less *liberal* than the other tribes of Guyana†. The language of the Caribbees of the Continent is the same from the sources of Rio Branco to the steppes of Cumana. I was fortunate enough to procure a manuscript, containing an extract, made by father Sebastian Garcia, of the *Gramatica de la lengua Caribe del P. Fernando Ximenes*. This valuable manuscript has been used in the researches made by

* *Diod.* lib. v, § 56; *Clavier*, vol. i, p. 283.

† “The Caribbees are tall and plump; but are little disposed to be liberal, for they like to feed on human flesh, lizards, and crocodiles.” (*Descript. gén. de l’Amérique par Pierre d’Avity, Seigneur de Montmartin, 1660, p. 118.*)

Mr. Vater *, and lately on a more comprehensive plan by my brother, Mr. William de Humboldt, on the structure of the American languages.

On quitting the mission of Cari, we had some difficulties to settle with our Indian muleteers. They had perceived to our great astonishment, that we had brought skeletons with us from the cavern of Ataruipe †; and they were firmly persuaded, that the beasts of burden, which carried “the bodies of their old relations,” would perish in the journey. Every precaution we had taken had been useless; nothing escapes the penetration and the sense of smell of a Caribbee, and it required all the authority of the missionary, to forward our baggage. We had to cross the Rio Cari in a boat, and the *Rio de agua clara*, by fording, I might almost say by swimming. The quicksands of the bed of this river render the passage very difficult at the season when the waters are high. The strength of the currents seems surprising in so flat a country; but the rivers of the steppes are precipitated, to use a fine expression of Pliny the younger ‡, “less by the declivity of their

* *Mithridates*, vol. iii, p. 685. Father Gili had no knowledge of this manuscript. *Saggio*, vol. iii, p. 410.

† See above, vol. v, p. 615—23.

‡ *Epist.*, lib. viii, ep. 8. “Clitumnus non loci devexitate, sed ipsa sui copia et quasi pondere impellitur.”

course, than by their abundance, and as it were by "their own weight." We had two bad stations, at Matagorda and at Los Riecetos, before we reached the little town of Pao. We met every where with the same objects; small huts constructed of reeds, and roofed with leather; men on horseback armed with lances guarding the herds; herds of cattle half wild, remarkable for their uniform colour, and disputing the pasturage with the horses and mules. No sheep or goats are found on these immense steppes! Sheep do not breed kindly in equinoctial America, except on the table-lands above a thousand toises high, where their fleece is long, and sometimes very fine. In the ardent climate of the plains, where the wolves give place to jaguars, these small ruminating animals, destitute of means of defence, and so slow in their movements, are unable to preserve themselves in great numbers.

We arrived on the 15th of July at the *Fundacion* or Villa del Pao, founded in 1744, and placed very favourably to serve as a commercial station between Nueva Barcelona and Angostura. Its real name is *el Concepcion del Pao*. Alcedo, La Cruz Olmedilla, and many other geographers, have mistaken its situation; confounding this small town of the Llanos of Barcelona either with San Juan Bautista del Pao of the Llanos of Caraccas, or with El Valle del Pao de Za-

rate *. Though the weather was cloudy, I succeeded in obtaining some heights of α Centauri, serving to determine the latitude of the place ; which is $8^{\circ} 37' 57''$. Some altitudes of the Sun gave me $67^{\circ} 8' 12''$ for the longitude, supposing Angostura to be $66^{\circ} 15' 21''$. The astronomical determinations of Calabozo † and Concepcion del Pao are sufficiently important to the geography of this country, where, in the midst of savannahs, fixed points are altogether wanting. Some fruit-trees grow in the vicinity of Pao, which is a rare circumstance in the steppes. We even found some cocoa trees, that appeared very vigorous, notwithstanding the great distance of the sea. I lay some stress on this last observation, because doubts have recently been started respecting the veracity of travellers, who assert, that they saw the cocoa tree, which is a *palm of the shore*, at Tombuctoo, in the centre of Africa ‡. It happened to us several times, to see cocoa trees amid the cultivated spots on the banks of the Rio Magdalena, more than a hundred leagues from the coast.

Five days, which to us appeared very tedious, brought us from Villa del Pao to the port of

* Caulin, p. 343. Depons, vol. iii, p. 209.

† See above, vol. iv, p. 377.

‡ According to the report of the sailor Adams, and that of hadjee Talub Ben Jelow, in Fitzclarence's Route across India, p. 494.

Nueva Barcelona. As we advanced, the sky became more serene, the soil more dusty, and the atmosphere more fiery. The heat, from which we suffered, is not entirely owing to the temperature of the air, but is produced by the fine sand mingled with it, that darts in every direction, and strikes against the face of the traveller, as it does against the ball of the thermometer. I never observed however the mercury rise in America, amid a *wind of sand*, above $45\cdot8^{\circ}$ cent. Captain Lyon, with whom I had the pleasure of an interview on his return from Mourzouk, appeared to me also inclined to think, that the temperature of fifty-two degrees, which is so often felt in Fezzan, is produced in great part by the grains of quartz suspended in the atmosphere. Between Pao, and the village of Santa Cruz de Cachipo, founded in 1749, and inhabited by five hundred Caribbees *, we passed the western elongation of the little table-land, known by the name of Mesa de Amana. This table-land forms a point of partition between the Oroonoko, the Guarapiche, and the coast of New Andalusja. It's height is so inconsiderable, that it would scarcely be an obstacle to the establishment of an inland navigation in this part of the Llanos. The Rio Mano however,

* The population, in 1754, was only one hundred and twenty souls. *Caulin*, p. 352.

which flows into the Oroonoko above the confluence of the Carony, and which D'Anville (I know not on what authority) has marked in the first edition of his great map as issuing from the lake of Valencia, and receiving the waters of the Guayra, could never have served as a natural canal between two basins of rivers. No bifurcation of this kind exists in the steppe. A great number of Caribbee Indians, who now inhabit the missions of Piritoo, were settled formerly at the north and east of the table-land of Amana, between Maturin, the mouth of the Rio Arco, and the Guarapiche; it was by the incursions of don Joseph Careno, one of the most enterprising governors of the province of Cumana, that a general migration of independant Caribbees toward the banks of the Lower Oroonoko in 1720 was occasioned.

The whole of this vast plain consists, as we have shown above*, of secondary formations; which toward the South rest immediately on the granitic mountains of the Oroonoko. Toward the north-west they are separated by a narrow band of *transition rocks* † from the primitive mountains of the shore of Caraccas. This abundance of secondary rocks, which cover without interruption a space of more than seven thou-

* Vol iv, p. 384—7.

† Vol. iv, p. 279—82.

sand square leagues (reckoning only that part of the *llanos*, which is bounded by the Rio Apure on the South, and by the Sierra Nevada de Merida and the Paramo de las Rosas on the West), is a phenomenon so much the more remarkable in that region of the globe, because in the whole of the Sierra de la Parima, between the right bank of the Oroonoko and the Rio Negro, there is, as in Scandinavia, a total absence of secondary formations. The *red sandstone*, containing some vestiges of fossil wood (of the family of monocotyledons), is seen every where in the steppes of Calabozo ; farther East it is overlaid by calcareous and gypseous rocks, which conceal it from the research of the geologist. The marly gypsum, of which we collected specimens near the Caribbee mission of Cachipo, appeared to me to belong to the same formation as the gypsum of Ortiz. To class it according to the type of European formations, I would range it among the gypsums, often muriatiferous, that cover the Alpine limestone, or *zechstein*. Farther North, toward the mission of San Josef de Curataquiche, Mr. Bonpland picked up in the plain some fine pieces of ribband jasper, or *Egyptian pebbles*. We did not see them in their native place enchased in the rock ; and are ignorant whether they belong to a very recent conglomerate, or to that limestone which we saw at the Morro of New Barcelona, and

which is not transition limestone, though it contains beds of schistous jasper (*kieselschiefer*).

It is impossible to cross the steppes or savannahs of South America, without indulging the hope, that science will one day profit from the many advantages they offer, above any other region of the Globe, for measuring the degrees of a terrestrial arch in the direction of a meridian, or perpendicularly to the meridian. Their great extent from east to west would render the measurement of some degrees of longitude extremely easy; and this operation would be very interesting with respect to the precise knowledge of the figure of the Earth. The *llanos* of Venezuela are thirteen degrees east of the places, where, on the one side, the French academicians, by triangles resting on the summits of the Cordilleras, and on the other, Mason and Dixon, renouncing (in the plains of Pennsylvania) the aid of trigonometry, executed their measurements; and they are nearly on the same parallel, which is a very important circumstance, as the table-land of India, between the Jumna and Madura, which was the theatre of Colonel Lambton's excellent operations. Whatever doubts may yet be entertained concerning the precision of instruments, the errors of observations, and the influence of local attractions, it would be difficult in the present state of our knowledge, to deny the inequalities of the flat-

tening of the Earth. When a more intimate connexion is established between the free governments of La Plata and Venezuela, advantage will no doubt be taken of the public tranquillity, to execute on the north and south of the equator, in the *llanos* and the *pampas*, the measurements we propose. The *llanos* of Pao and Calabozo are nearly under the same meridian as the *pampas* south of Cordova; and the difference of latitude of these plains, as smooth as if they had been levelled by a long abode of the waters, is forty-five degrees. These geodesic and astronomical observations would cost little, on account of the nature of the places. In 1734 La Condamine* showed how much more useful and expeditious it would have been, to have sent the academicians into the plains (perhaps somewhat too woody and marshy), that extend on the south of Cayenne toward the confluence of the Rio Xingu and Amazon, than to have compelled them to struggle, on the table-land of Quito, with cold, with tempests, and with the eruptions of volcanoes.

The Spanish American governments ought not to consider the projected operations in the

* *Voy., à l'Equat.*, p. 194 and 201. If we were to seek for a country entirely flat and open, *under the equator itself*, I should prefer the plains extending south of the chain of the mountains of Pacaraymo, toward the mouth of the Rio Branco, to those which have been noted by M. de la Condamine. See above, vol. v, p. 789 and 861.

llanos, combined with the observations of the pendulum, as interesting to science alone; they are at the same time the principal bases of maps, without which any regular administration of the affairs of a country is impossible. Hitherto this has been necessarily limited to a simple astronomical sketch; this being the surest and most ready means on a surface of large extent. Attempts have been made, to determine the longitude of certain points on the coast and in the interior in an *absolute* manner; that is, by celestial phenomena, or series of lunar distances. The most important places have been fixed according to the three coördinates of latitude, longitude, and height. The intermediate points have been deduced *chronometrically* from the principal points. The very uniform movement of the chronometers in the boats, and the strange inflexions of the Oroonoko, have facilitated this connection. By bringing the chronometers to the point of departure; or by observing twice, going and coming, at an intermediary point, joining the extremities of the *chronometric lines** at two places very distant from each

* I mean by this expression, perhaps improper, the lines that unite points, the longitude of which has been determined by means of the chronometer, and which are consequently dependant on one another. It is on the proper disposition of these lines, that the precision of a measurement merely astronomical depends.

other, and the position of which is founded on absolute or simply astronomical phenomena; we are capable of estimating the sum of the errors that may have been committed. It was thus (and no determination of longitude had been made before me in the interior) that I connected astronomically Cumana, Angostura, Esmeralda, San Carlos del Rio Negro, the Great Cataracts, San Fernando de Apure, Portocabello, and Caraccas. These determinations contain within just limits an *area* of more than ten thousand square leagues. The system of the positions on the shore, and the valuable results of the plans executed by the maritime expedition of Fidalgo, have been joined to the system of the positions on the Oroonoko and the Rio Negro by two chronometric lines, one of which crosses the *llanos* of Calabozo, and the other the *llanos* of Pao. The observations on the Parima present a band, that divides into two parts an immense extent of land (seventy-three thousand square leagues) of various kinds, not one point of which had till then been astronomically determined*. These labours, which I undertook with feeble means, but according to a general plan, have furnished, I venture to flatter myself, the first astronomical basis of the geography of those countries; but it is time to multiply them, to improve them,

* See above, vol. v, p. 788, note †.

and above all to substitute for them, where the cultivation of the country permits, trigonometric operations. On the two borders of the llanos, that extend like a gulf from the delta of the Oroonoko to the snowy mountains of Merida, two granitic chains, toward the north and toward the south, stretch parallel to the equator. These ancient coasts of an interior basin are visible from afar in the steppes, and might serve to establish signals. The Peak of Guacharo, Cocollar, and Tumiriquiri, the Bergantin, the Morros of San Juan and San Sebastian, the Galera, that bounds the *llanos* like a rocky wall, the little Cerro de Flores which I saw at Calabozo, and this at a moment when the *mirage* was almost null, will serve for the series of triangles toward the northern limit of the plains. A great part of these summits is visible at the same time in the *llanos*, and in the cultivated stripe of the coast. Toward the south the granitic chains of the Oroonoko or the Parima are a little distant from the borders of the steppe, and less favorable to geodesic operations. The mountains however, that rise above Angostura and Maitaco, the Cerro del Tirano near Caya-cara, the Pan de Azucar, and Sacuima near the confluence of the Apure and the Oroonoko, may be very useful; especially if the angles be taken in cloudy weather, so that the play of extraordinary refractions over a soil strongly

heated may not disfigure or displace the summits of mountains seen under angles of too little altitude. Signals by firing gunpowder, the reflection of which toward the sky is distinguished at such a distance, will be of considerable assistance. I thought it might be useful to mention in this place what I had derived from my knowledge of the localities, and my study of the geography of America. Mr. Lanz, a distinguished geometrician, who unites with an extensive knowledge of every branch of mathematics the practical use of astronomical instruments, is at present employed in improving the geography of those countries ; and in executing, under the auspices of the free government of Venezuela, a part of the projects, to which in the year 1799 I in vain called the attention of the Spanish ministry.

We rested on the night of the 16th of July in the Indian village of Santa Cruz de Cachipo. This mission was founded in 1749 by the union of several Caribbee families ; who inhabited the inundated and unhealthy banks of the *Lagunetas de Auache*, opposite the confluence of the Zir Puruay with the Oroonoko. We lodged at the house of the missionary* ; and, on examining the registers of the parish, we saw how rapid a progress the prosperity of the community

* Fray Jose de las Piedras.

had made, owing to his zeal and intelligence. Since we had reached the middle of the steppes, the heat had increased to such a degree, that we should have preferred travelling no more during the day; but we were without arms, and the *llanos* were then infested by an immense number of robbers, who assassinated the whites that fell into their hands with an atrocious refinement of cruelty. Nothing is more deplorable than the administration of justice in the colonies beyond sea. We every where found the prisons filled with malefactors, on whom sentence is not passed till after waiting seven or eight years. Nearly a third of the prisoners succeed in making their escape; and the unpeopled plains, filled with herds, afford them both an asylum and food. They commit their depredations on horseback, in the manner of the Bedoweens. The insalubrity of the prisons would be at its height, if they were not emptied from time to time by the flight of the prisoners. It often happens also, that sentences of death, tardily pronounced by the *audiencia* of Caraccas, cannot be executed for want of a hangman. In these cases a barbarous custom prevails, which I have already mentioned, of pardoning one criminal on the condition of his hanging the others. Our guides related to us, that a short time before our arrival on the coast of Cumana, a Zambo, known for the great ferocity of his

manners, determined to screen himself from punishment by becoming the executioner. The preparations for the execution however shook his resolution ; he felt a horror of himself, and, preferring death to the disgrace of thus saving his life, called again for his irons, which had been struck off. He did not long suffer detention, and underwent his sentence by the baseness of one of his accomplices. This awakening of a sentiment of honour in the soul of a murderer is a psychologic phenomenon worthy of reflection. The man, who had so often shed blood when stripping the traveller in the steppe, recoiled at the idea of becoming the passive instrument of justice, to inflict upon others a punishment, which he felt perhaps he himself deserved.

If, in the peaceful times when Mr. Bonpland and myself had the good fortune to travel through both Americas, the *llanos* were even then the refuge of malefactors, who had committed crimes in the missions of the Oroonoko, or who had escaped from the prisons on the coast, how much worse must this state of things have become in consequence of civil discords, and amid that sanguinary struggle, which has terminated by giving liberty and independance to those vast regions ! Our wastes and heaths are but a feeble image of the savannahs of the New Continent, which for the space of eight or ten thousand square leagues are smooth as the

surface of the sea. The immensity of their extent insures impunity to vagabonds; for they are better concealed in the savannahs than in our mountains and forests; and it is easy to conceive, that the artifices of a European police could not be easily put in practice, where there are travellers and no roads, herds and no herdsmen, and farms so solitary, that, notwithstanding the powerful action of the *mirage*, several days' journey may be made without seeing one appear within the horizon.

In traversing the *llanos* of Caraccas, Barcelona, and Cumana, which succeed each other from west to east, from the snowy mountains of Merida to the Delta of the Oroonoko, we ask ourselves, whether these vast tracts of land be destined by Nature to serve eternally for pasture, or the plough and the spade of the labourer will one day subject them to cultivation. This question is so much the more important, as the *llanos*, placed at the two extremities of South America, are obstacles to the political union of the provinces they separate. They prevent the agriculture of the coast of Venezuela from extending toward Guyana, and that of Potosi toward the mouth of the Rio de la Plata. The interposed steppes preserve with the pastoral life something rude and wild, which separates and keeps them remote from the civilization of countries anciently cultivated.

It is for the same reason, that in the war of independance, they have been the theatre of the struggle between the hostile parties, and that the inhabitants of Calabozo have almost seen the fate of the confederated provinces of Venezuela and Cundinamarca decided under their walls. I could wish, that in assigning limits to the new states, and to their subdivisions, there may be found no cause to repent *hereafter* having lost sight of the importance of the *llanos*, and the influence they may have on the disunion of communities, which important common interests should bring together. The stepes would serve for natural limits, like the seas, or the virgin forests of the tropics, if armies could not cross them with a facility so much the greater, as they furnish in their innumerable troops of horses and mules, and herds of oxen, all the means of conveyance and subsistence.

In no other part of the world are the configuration of the ground and the state of it's surface marked by stronger features; and no where do they act more sensibly on the divisions of the social body, already divided by the original difference of colour, and by individual liberty. It is not in the power of man to change that diversity of climates, which the inequalities of the soil produce on a small space of ground, and which give rise to the antipathy of the inha-

bitants of *tierra caliente* for those of *tierra fria*; an antipathy founded on the modifications of character, habits, and manners. These moral and political effects are manifested especially in countries, where the extremes of height and depression are most striking, where the mountains and the low lands have the greatest mass and extent. Such are New Grenada or Cundinamarca, Chili, and Peru, where the language of the inca furnishes many happy and natural expressions to denote this climatic opposition of constitution, inclinations, and intellectual faculties. In the state of Venezuela on the contrary, the *montaneros* of the lofty mountains of Bocono, Timotes, and Merida, form but a very slight part of the total population; and the populous valleys of the chain of the coast of Caraccas and Caripe are but three or four hundred toises above the level of the sea. It hence results, that in the political union of the states of Venezuela and New Grenada under the name of Columbia, the great mountain population of Santa-Fé, Popayan, Pasto, and Quito, has been balanced, if not entirely, at least more than half, by the addition of eight or nine hundred thousand inhabitants of *tierra caliente*. The state of the surface of the soil is less immutable than it's configuration. We may conceive the possibility of seeing the marked oppositions between the impenetrable forests of Guyana, and

the *llanos* destitute of trees and covered with grass, in time disappear : but what ages must pass, to render any change sensible in the immense steppes of Venezuela, Meta, Caqueta, and Buenos Ayres ! What we have seen of the power of man struggling against the force of nature in Gaul, in Germany, and recently, but still beyond the tropics, in the United States, can scarcely give any just measure of what we must expect from the progress of civilization in the torrid zone. I have mentioned above how slowly forests are made to disappear by fire and the axe, when the trunks of trees are from eight to ten feet in diameter ; and when in falling they rest one upon the other, and their wood, moistened by almost continual rains, is of an excessive hardness. The planters, who inhabit the *llanos* or *pampas*, do not generally recognize the possibility of subjecting the soil to cultivation ; it is a problem which is not yet solved in a general view. The savannahs of Venezuela have not for the most part the same advantage as those of North America, which are traversed longitudinally by three great rivers, the Missouri, the Arkansas, and the Red River of Natchitoches ; the savannahs of Araucaria, Calabozo, and Pao, are crossed in a transverse direction only by the tributary streams of the Oronoko, the westernmost of which (the Cari, the Pao, the Acaru, and the Manapire)

have very little water in the season of drought. These streams scarcely flow at all toward the north ; so that in the centre of the steppes there remains vast tracts of land (*bancos* and *mesas*) frightfully parched. The eastern parts, fertilized by the Portuguesa, the Masparro, and the Orivante, and by the tributary streams, which are very near each other, of these three rivers, are the most susceptible of cultivation. The soil is sand mixed with clay, covering a bed of quartz pebbles. The vegetable mould, the principal source of the nutrition of plants, is every where extremely thin. It is scarcely augmented by the fall of the leaves ; which, though less periodical in the forests of the torrid zone, takes place however, as in temperate climates. During thousands of years the *llanos* have been destitute of trees and brushwood ; a few scattered palms in the savannah add little to that hydruret of carbon, that extractive matter, which (according to the experiments of Saussure, Davy, and Braconnot) gives fertility to the soil. The social plants, that almost exclusively predominate in the steppes, are monocotyledons ; and it is known how much grasses impoverish the soil, into which their roots with close fibres penetrate. This action of the killingias, paspalums, and cenchri, which form the turf, is every where the same ; but where the rock is ready to pierce the earth, this varies according

as it rests on red sandstone, or on compact limestone and gypsum ; it varies according as periodical inundations have accumulated mud on the lower grounds, or as the shock of the waters has carried away from the small elevations the little soil that covered them. Many solitary cultivated spots already exist in the midst of the pastures, where running water, and tufts of the mauritia palm, have been found. These farms, sown with maize, and planted with cassava, will multiply considerably, if an increase of the trees and shrubs be effected.

The aridity and the excessive heat of the *mesas** do not depend solely on the state of their surface, and the local reverberation of the soil ; their climate is modified by the adjacent regions, by the whole steppe of which they form a part. In the deserts of Africa or Arabia, in the *llanos* of South America, in the vast heaths that reach from the extremity of Jutland to the mouth of the Scheldt, the stability of the limits of the desert, the savannahs, and the downs, depends for the most part on their immense extent, and the nakedness these plains have acquired from some revolution destructive of the ancient vegetation of our planet. By their extent, their continuity, and their mass,

* Little table-lands, *banks*, parts more elevated than the rest of the steppe.

they oppose the inroads of cultivation, and preserve, like inland gulfs, the stability of their boundaries. I will not touch upon the great question, whether in the Sahara, that Mediterranean of moving sands, the germs of organic life are increased in our days. In proportion as our geographical knowledge has extended, we see in the eastern part of the desert islets of verdure, oases covered with date-trees, crowd together in more numerous archipelagoes, and open their ports to the caravans; but we are ignorant whether the form of the oases have not remained constantly the same since the time of Herodotus. Our annals are too incomplete and too short, to follow Nature in her slow and progressive progress. From these spaces entirely bare, whence some violent catastrophe has swept away the vegetable covering and the mould; from those deserts of Syria and Africa, which, by their petrified wood, attest the changes they have undergone; let us now turn our eyes to the *llanos* covered with grasses, to the discussion of phenomena that come nearer the circle of our daily observations. The planters settled in the steppes of America have formed respecting the possibility of a more general cultivation the same opinions, as those which I deduced from the climatic action of these steppes considered as surfaces, or continuous masses. They have observed, that downs en-

closed within cultivated and wooded land resist the labourer a shorter time than soils alike circumscribed, but making part of a vast surface of the same nature. This observation is in fact extremely just, whether the soil be covered with heath, as in the north of Europe ; with cistuses, mastic-trees, or palmettoes, as in Spain ; or with cactuses, argemones, or brathys, as in equinoctial America. The more space the association occupies, the more resistance do the social plants oppose to the labourer. With this general cause are joined in the *llanos* of Venezuela the action of the small grasses, that impoverish the soil ; the total absence of trees and brushwood ; the sandy winds, the ardour of which is increased by the contact of a surface, that absorbs the rays of the Sun during twelve hours, and on which no shadow is ever projected, except that of the stalks of the aristides, chanchuses, and paspalums. The progress, which the vegetation of large trees, and the cultivation of dicotyledonous plants, have made in the vicinity of towns, for instance around Calabozo and Pao, prove what may be gained upon the steppe, by attacking it in small portions, enclosing it by degrees, and dividing it by copses, and canals of irrigation. Perhaps the influence of the winds, which render the soil sterile, might be diminished, by sowing in the large way, as on fifteen or twenty acres, the seeds of the

psidium, the croton, the cassia, or the tamarind, which prefer dry and open spots. I am far from believing, that men will ever cause the savannahs to disappear entirely; and that the *llanos*, useful for pasturage and the commerce of cattle, will ever be cultivated like the vallies of Aragua, or other parts near the coast of Caraccas and Cumana: but I am persuaded, that in the lapse of ages a considerable portion of these plains, under a government favorable to industry, will lose the savage aspect they have preserved since the first *conquest* of the Europeans.

These progressive changes, this increase of population, will not only augment the prosperity of those countries, but will also exert a beneficial influence on their moral and political state. The *llanos* form more than two thirds of that part of the ancient *capitania general* of Caraccas, which is situate to the north of the Oroonoko and the Rio Apure. Now, in times of civil troubles, the vast steppes, by their solitude, and the abundant subsistence they offer in their innumerable herds, serve at once as an asylum and support to a party, that is desirous of raising the standard of revolt. Armed bands (*guerillas*) may maintain themselves, and annoy the rear of the inhabitants of the coast, among whom civilization and agricultural wealth are concentrated. If the Lower Oroonoko were not sufficiently

defended by the patriotism of a robust and warlike population, the present state of the *llanos* would render the effects of a foreign invasion on the western coasts doubly dangerous. The defence of the plains is intimately connected with that of Spanish Guyana; and, in speaking above* of the strategic importance of the mouths of the Oroonoko, I have shown, that the numerous fortresses and batteries, which have been raised along the northern coast from Cumana to Carthagena, are not the real ramparts of the United Provinces of Venezuela. To this important political view may be added another of not less consequence, and still more permanent. An enlightened government cannot see without regret, that the habits of a pastoral life, which cherish idleness and a vagabond spirit, prevail in more than two thirds of it's territory. That part of the population of the coast, which flows annually toward the *llanos*, to fix itself in the *hatos de ganado*†, and take care of the herds, makes a retrograde step in civilization. How can it be doubted, that the progress of agriculture, and the multiplication of villages where there is running wa-

* Vol. v, p. 709—15.

† A sort of farm composed of sheds, that serve as a dwelling for men (*hateros*, or *peones para el rodeo*), who take care of the half-wild herds of cattle and horses, or rather inspect them.

ter, would lead to a sensible melioration in the moral state of the inhabitants of the steppe? Softer manners, a taste for a sedentary way of life, and domestic virtues, would penetrate into them with agricultural labours.

After three days' journey, we began to perceive the chain of the mountains of Cumana, which separates the *llanos*, or, as they are often called here *, "the great sea of verdure," from the coast of the Caribbean sea. If the Bergantin be more than eight hundred toises high, it may be seen supposing only an ordinary refraction of one fourteenth of the arch, at twenty-seven nautical leagues distance †; but the state of the atmosphere long concealed from us the majestic view of this curtain of mountains. It appeared at first like a fog bank, which hid the stars near the pole at their rising and setting; by degrees this body of vapours seemed to augment, condense, take a bluish tint, and become bounded by sinuous and fixed outlines. All that the mariner observes on approaching a new land presents itself to the traveller on the borders of the steppe. The horizon begins to enlarge in some part, and the vault of the sky seems no longer to rest at an equal distance on the soil covered with grass. An inhabitant of the *llanos* is happy only when, according

* "Los lanos son como un *mar de yerbas*."

† Vol. ii, p. 206; and iii, p. 91.

to the simple expression of the country, "he can see every where well around him." What appears to us a covered country, slightly undulated, with a few scattered hills, is to him a frightful region bristled with mountains. Every thing is relative in our judgments on the inequality of the ground, and the state of the surface. After having passed several months in the thick forests of the Oroonoko, in places where you are accustomed when at any distance from the river, to see the stars only in the zenith, as through the mouth of a well, a journey in the steppes has something in it agreeable and attractive. The traveller feels new sensations ; and, like the *llanero*, enjoys the happiness " of seeing well around him." But this enjoyment, as we ourselves experienced, is not of long duration. There is no doubt something solemn and imposing in the aspect of a boundless horizon, whether viewed from the summits of the Andes or the highest Alps, amid the immensity of the ocean, or in the vast plains of Venezuela and Tucuman. Infinity of space, as poets have said in every language, is reflected in ourselves ; it is associated with ideas of a superior order ; it elevates minds, that delight in the calm of solitary meditation. It is true also, that every view of an unbounded space bears a peculiar character. The view enjoyed from a solitary peak, varies according as the clouds reposing on

the plain extend in lavers, are conglomerated in groups, or present to the astonished eye through broad openings the habitations of man, the labour of the fields, or the verdant tint of the ærial ocean. An immense sheet of water, animated by a thousand various beings even to it's utmost depths, changing perpetually it's colour and it's aspect, movable at it's surface like the element that agitates it, charms the imagination in long voyages by sea; but the dusty and creviced steppe, during a great part of the year, dejects the mind by it's unchanging monotony. When, after eight or ten days' journey, the traveller becomes accustomed to the play of the *mirage*, and the brilliant verdure of a few tufts of mauritia * scattered from league to league, he feels the want of more varied impressions; he wishes to see again the great trees of the tropics, the wild rush of torrents, or hills and vallies cultivated by the hand of the labourer. If, unhappily, the phenomenon of the deserts of Africa, and that of the *llanos* or savannahs of the New Continent (a phenomenon the cause of which is lost in the obscurity of the first history of our planet), filled a still greater space, nature would be deprived of a part of the beautiful productions, which are peculiar to the torrid zone †. The heaths of the north, the steppes of

* Fan palm, sago-tree of Guyana.

† In calculating from maps constructed on a very large

the Wolga and the Don, are scarcely poorer in species of plants and animals, than are twenty-eight thousand square leagues of savannahs, that extend in a semicircle from north-east to south-west, from the mouths of the Oronoko to the banks of the Caqueta and the Putumayo, beneath the finest sky of the globe, and in the climate of plantains and breadfruit trees. The influence of the equinoctial climate, every where else so vivifying, is not felt in places, where the great associations of graminea have almost excluded every other plant. From the view of the ground we might have believed we were in the temperate zone, and even still farther toward the north: but a few scattered palms, and, at the entrance of the night, the fine constellations

scale, I found the *llanos* of Cumana, Barcelona, and Caracas, from the delta of the Oronoko to the northern bank of the Apure, seven thousand two hundred square leagues; the *llanos* between the Apure and Putumayo, twenty-one thousand leagues; the *pampas* on the north-west of Buenos-Ayres, forty thousand square leagues; the *pampas* south of the parallel of Buenos-Ayres, thirty-seven thousand square leagues. The total area of the *llanos* of South America, covered with gramina, is consequently one hundred and five thousand two hundred square leagues, twenty leagues to an equatorial degree. (Spain has fifteen thousand of the same leagues.) The great plain of Africa, known by the name of Sahara, contains ten thousand square leagues, including the scattered oases, but not Bornou or Darfour. (The Mediterranean has only about eighty-nine thousand square leagues of surface.) See above, vol. iv, p. 314.

of the southern sky, (the Centaur, Canopus, and the innumerable nebulae with which the Ship is resplendent,) had not reminded us, that we were only eight degrees distant from the equator.

A phenomenon, which had already fixed the attention of Deluc, and which in these latter years has exercised the sagacity of geologists, occupied us much during our journey across the steppes. I allude, not to those blocks of primitive rocks, which occur, as in the Jura, on the slope of limestone mountains, but to those enormous blocks of granite and syenite, which, in limits very distinctly marked by nature, are found scattered in the north of Holland, Germany, and the countries of the Baltic. It seems to be now proved, that, distributed as in radii, they came, at the time of the ancient revolutions of our globe, from the Scandinavian peninsula toward the south, and did not primitively belong to the granitic chains of the Harz and Erzgebirg, which they approach, without however reaching their foot *. Born in the sandy plains of the Baltic regions, and having till the age of eighteen known the existence of a rock only by these scattered blocks, I was doubly curious to see, whether the New World would shew me any analogous phenomenon. I was surprised at not

* Leopold de Buch, *Voyage en Norwège*, vol. i, p. 30.

seeing one of these blocks in the *llanos* of Venezuela, though these immense plains are bounded on the south by a group of mountains entirely granitic*, and exhibiting in it's denticulated and often columnar peaks traces of the most violent destruction †. Toward the north, the granitic chain of the Silla de Caraccas and Portocabello are separated from the *llanos* by a skreen of mountains, that are schistous between Villa de Cura and Parapara, and calcareous between the Bergantin and Caripe. I was no less struck by this absence of blocks on the banks of the Amazon. La Condamine had indeed affirmed, that, from the Pongo de Manseriche to the strait of Pauxis not the smallest stone was to be found. Now the basin of the Rio Negro and of the Amazon is also but a *llano*, a plain like those of Venezuela and Buenos-Ayres. The difference consists only in the state of vegetation. The two *llanos*, situate at the northern and southern extremities of South America, are covered with gramina ; they are savannahs destitute of tress : the intermediate *llano*, that of the Amazon, exposed to almost continual equatorial rains, is a thick forest. I do not remember having heard, that

* The *Sierra Parima*.

† Vol. iv, p. 461, 468, 469, 540, 568 ; vol. v, p. 177, 616, 676, 687.

the *pampas* of Buenos Ayres, or the savannah of the Missouri * and New Mexico, contain granitic blocks. The absence of this phenomenon appears general in the New World : and is so probably also in Sahara, in Africa ; for we must not confound the rocky masses, that pierce the soil in the middle of the desert, and of which travellers often make mention, with simple scattered fragments. These facts seem to prove, that the blocks of Scandinavian granite, which cover the sandy countries situate to the south of the Baltic, and those of Westphalia and Holland, are owing to a particular rupture coming from the north, to a local revolution. The ancient conglomerate (red sandstone), that covers, according to my observations, a great part of the *llanos* of Venezuela and of the basin of the Amazon, contain no doubt fragments of the same primitive rocks, as constitute the neighbouring mountains ; but the convulsions, of which these mountains exhibit evident marks, do not appear to have been attended by circumstances favorable to the removal of great blocks. This geognostic phenomenon was to me the more unexpected, since there exists no where in the world a smoother plain stretching as far as to the abrupt declivity of the Cordillera entirely

* Are there any blocks in North America to the north of the great lakes ?

granitic. Even before my departure from Europe, I had observed with surprise, that primitive blocks were alike wanting in Lombardy, and in the great plain of Bavaria, which appears to be the bottom of an ancient lake, raised two hundred and fifty toises above the level of the ocean. It is bounded on the north by the granites of the Upper Palatinate; and on the south by Alpine limestone, transition-*thonschiefer*, and the mica-slates of the Tyrol.

We arrived, July the 23d, at the town of Nueva Barcelona, less fatigued by the heat of the *llanos*, to which we had been long accustomed, than by the *winds of sand*, which occasion painful chaps in the skin. Seven months before, in going from Cumana to Caraccas, we had rested a few hours at the *Morro de Barcelona*, a fortified rock, which, toward the village of Pozuelos, is joined to the continent only by a neck of land. We were received in the most affectionate manner, and with the kindest hospitality, in the house of a wealthy merchant of French extraction, don Pedro Lavié. Accused of having given an asylum to the unfortunate España, when he was a fugitive on these coasts in 1796, Mr. Lavié was arrested by the orders of the *Audiencia*, and dragged as a prisoner to Caraccas. The friendship of the governor of Cumana, and the remembrance of the services he had rendered to the dawning industry of those

countries, contributed to procure for him his liberty. We had endeavoured to soften his captivity by visiting him in his prison ; and we had now the satisfaction of finding him in the midst of his family. His physical complaints had been aggravated by confinement ; and he has sunk into the grave, without having seen the light of those days of independance, which his friend, don Joseph España, had predicted at the moment of his execution. “I die,” said this man formed for the accomplishment of grand projects *, “I die an ignominious death ; but my fellow citizens will soon piously collect my ashes, and my name will reappear with glory.” These remarkable words were uttered in the public square of Caraccas, on the 8th of May, 1799 ; they were repeated to me the same year by persons, some of whom abhorred the projects of España, as much as the others deplored his fate.

I have spoken above † of the importance of the trade of Nueva Barcelona. This small town, which in 1790 had scarcely ten thousand inhabitants, and in 1800 more than sixteen thousand, was founded ‡ by a Catalonian con-

* *Essai Polit. sur la Nouv. Espagne*, tom. ii, p. 819. See also vol. iii, p. 414 of the present work.

† See above, vol. iii, p. 361.

‡ *Caulin*, p. 173, 199, 207. What Mr. Depons relates (vol. iii, p. 205,) of the origin of this town, is not altogether conformable to history.

quistador, Juan Urpin, in 1637. A fruitless attempt was then made, to give the whole province the name of New Catalonia. As our maps often mark two towns, Barcelona and Cumanagoto, instead of one, and the two names are considered as synonymous, it may be useful to clear up the cause of this error. Anciently at the mouth of the Rio Nevers, there was an *Indian* town, built in 1588 by Lucas Faxardo, and named *San Cristoval de los Cumanagotos*. This town was peopled solely by natives who came from the saltworks of Apaicuare. In 1637, Urpin founded, two leagues farther inland, the *Spanish* town of *Nueva Barcelona*, which he peopled with some of the inhabitants of Cumanagoto and many Catalonians. For thirty-four years quarrels were incessantly arising between the two neighbouring communities, till 1671, when the governor Angulo succeeded in persuading them, to unite on a third spot, where the town of Barcelona now stands; the latitude of which, according to my observations *, is $10^{\circ} 6' 52''$.

* *Plaza Mayor*. This is only the result of six circummeridian heights of Canopus, taken in the same night. *Las Memorias d'Espinosa* (vol. ii, p. 80) give $10^{\circ} 9' 6''$. Mr. Ferrer found (*Conn. des Tems*, 1817, p. 322) $10^{\circ} 8' 24''$. I know not where these observations were made, but I believe they give the latitude too far north. For, at Caraccas, Guyana, and the Havannah, my observations differed only a few seconds from those of Mr. Ferrer. The difference of latitude between the town and the *Morro* appeared to me to be

The ancient town of Cumanagoto is celebrated in the country for a miraculous image of the Virgin *, which the Indians say was found in the hollow trunk of a *tutumo*, or old calabash tree (*crescentia cujete*). This virgin was carried in procession to Nueva Barcelona; but whenever the clergy were dissatisfied with the inhabitants of the new city, she fled away at night, and returned to the trunk of the tree at the mouth of the river. This prodigy did not cease, till a large and fine convent (the college of the *Propaganda*) was built, to receive the monks of Saint Francis. We have seen above, that, in a similar case, the bishop of Caraccas caused the image of Our Lady *de los Valencianos* to be placed in the archives of the bishoprick, where she remained thirty years under seal.

The climate of Barcelona is not so hot as that of Cumana, but extremely damp, and

3' 40". I have elsewhere discussed the longitude of Nueva Barcelona, and the results of my chronometrical determinations compared with those of Messrs. Fidalgo and Ferrer (*Observ. Astr. Tom. ii, p. 80*). On the banks of the Rio Unare, and farther west on the Rio Ucheri, near the beautiful valley of Cupira, so abundant in cacao, there existed two other towns in the seventeenth century, by the names of Tarragona and San Miguel de Batei.

* *La milagrosa imagen de Maria Santissima del Socorro*, also called *la Virgen del Tutumo*.

somewhat unhealthy in the rainy season. Mr. Bonpland had supported well the difficult journey across the *llanos*; and had regained his strength, and his great activity. With respect to myself, I suffered more at Barcelona than I had done at Angostura, immediately after having terminated the navigation of the rivers. One of those extraordinary tropical rains, during which at sunset drops of an enormous size fall at great distances from one another, had given me such uneasy sensations, as seemed to menace an attack of the typhus, which then prevailed on that coast. We remained near a month at Barcelona, under the care of the most watchful friendship. We there found also that excellent ecclesiastic, fray Juan Gonzales, of whom I have often spoken, and who had traversed the Upper Oroonoko before us. He regretted the little time we had been able to employ in visiting that unknown country; and examined our plants and animals with that interest, which we feel for the productions of a distant region, that we have once inhabited. Fray Juan had resolved to go to Europe, and to accompany us as far as the island of Cuba. From this time we were together for seven months; he was gay, intelligent, and obliging. Who could foresee the evils, that awaited him? He took charge of a part of our collections; a common friend confided to him a child, that he

wished to have educated in Spain : the collections, the child, and the young ecclesiastic, were all buried in the waves *.

South-east of Nueva Barcelona, at the distance of two leagues, rises a lofty chain of mountains, abutting on the *Cerro del Bergantin*, which is visible at Cumana. This spot is known by the name of the *hot waters* (*aguas calientes*). When I felt my health sufficiently restored, we made an excursion thither on a cool and misty morning. The waters, loaded with sulphuretted hydrogen, issue from a quartzous sandstone, lying on the same compact limestone, which we had examined at the Morro. We again found in this limestone intercalated beds of black hornstein, passing into *kieselschiefer*. It is not however a transition rock ; it rather approaches, by it's position, it's division into small strata, it's whiteness, and it's dull and conchoidal fractures, (with very flattened cavities) the limestone of Jura. The real *kieselschiefer* and Lydian stone have not been observed hitherto except in the transition slates and limestones. Is the sandstone, from which the springs of the Bergantin issue, of the same formation as the sandstone which we described † at the Impossible and at Tumiriquiri?

* See above, vol. iii, p. 350 ; vol. v, p. 622.

† Vol. iii, p. 23 and 94.

The thermal waters have only a temperature of $43\cdot2^{\circ}$ cent. (the atmosphere being 27°); they flow first to the distance of forty toises over the rocky surface of the ground; are then precipitated into a natural cavern; and pierce through the limestone, to issue out at the foot of the mountain, on the left bank of the little river Narigual. The springs, while in contact with the oxygen of the atmosphere, deposit a good deal of sulphur. I did not collect, as I had done at Mariara, the bubbles of air, that rise in jets from these thermal waters. They no doubt contain a large quantity of azot, because the sulphuretted hydrogen decomposes the mixture of oxygen and azot dissolved in the spring. The sulphurous waters of San Juan, which issue from calcareous rock like those of Bergantin, have also but a weak temperature ($31\cdot3^{\circ}$); while in the same region, the temperature of the sulphurous waters of Mariara and las Trincheras (near Portocabello), which gush immediately from gneiss-granite, is $58\cdot9^{\circ}$ the former, and $90\cdot4^{\circ}$ the latter *. It would seem as if the heat, which these springs acquire in the interior of the globe, diminishes in proportion as they pass from primitive to secondary superposed rocks.

* L. c. Vol. iv, p. 52, 195, 272. I am ignorant of the temperature of the hot, and hydrosulphurous springs of Provisor, near San Diego, half a league distant from Nueva Barcelona, toward the south.

Our excursion to the *aguas calientes* of Bergantin ended with a vexatious accident. Our host had lent us one of his finest saddle horses. We were warned at the same time not to ford the little river of Narigual. We passed over a sort of bridge, or rather some trunks of trees placed close together, and we made our horses swim, holding their bridles. The horse I had rode suddenly disappeared, after struggling for some time under water : all our researches to discover the cause of this accident were fruitless. Our guides conjectured, that the animal's legs had been seized by the *caymans*, which abound in those parts. My perplexity was extreme : the delicacy and the fortune of my host forbade me to think of repairing his loss ; and Mr. Lavie, more attentive to our situation, than to the fate of his horse, endeavoured to tranquillize us by exaggerating the facility, with which fine horses were procurable from the neighbouring savannahs.

The crocodiles of the Rio Neveri are large and numerous, especially near the mouth of the river ; but in general they are less fierce than the crocodiles of the Oroonoko. These animals display the same contrasts of ferocity in America as in Egypt and Nubia, which we recognize when we compare with attention the narrative of the unfortunate Burckhardt, and that of Mr. Belzoni. The state of cultivation of different

countries, and the population more or less accumulated in the proximity of rivers, modify the habits of these large *sauriens*, timid when on dry ground, and fleeing from man even in the water, when they find abundant nourishment, and when they perceive any danger in attacking him. The Indians of Nueva Barcelona convey wood to market in a singular manner. Large logs of *zygophyllum* and *cæsalpinia** are thrown into the river, and carried down by the stream, while the proprietor of the wood and his eldest son swim here and there, to set afloat the pieces, that are stopped by the windings of the banks. This could not be done in the greater part of those American rivers, in which crocodiles are found. The town of Barcelona has not, like Cumana, an Indian suburb; and if some natives be seen, they are inhabitants of the neighbouring missions, or of huts scattered in the plain. Neither the one nor the other are of the Caribbee race, but a mixture of the Cumanagotoes, Palenkas, and Piritoos, short, stunted, indolent, and addicted to drinking. Fermented cassava is here the favorite beverage; the wine of the palm tree, which is used in

* The *lecythis ollaria* in the vicinity of Nueva Barcelona furnishes excellent timber. We saw trunks of this tree seventy feet high. Around the town, beyond that arid zone of cactus which separates Nueva Barcelona from the steppe, grow the *clerodendrum tenuifolium*, the *ionidium itubu*, which resembles the *viola*, and the *allionia violacea*.

Oroonoko, being almost unknown on the coast. It is curious to observe, that men in different zones, to satisfy the passion of inebriety, employ not only all the families of monocotyledonous and dicotyledonous plants, but even a poisonous agaric (*amanita muscaria*), of which, with disgusting economy, the Coriaks have learnt to drink the same juice several times during five successive days*.

The packet boats (*correos*) from Corunna bound for the Havannah and Mexico had been due three months; and it was believed they had been taken by the English cruisers stationed on this coast. Anxious to reach Cumana, in order to avail ourselves of the first opportunity that might offer for Vera Cruz, we hired an open boat (*lancha*). These craft are employed habitually in the latitudes east of cape Codera, where the sea is scarcely ever rough. The

* Mr. Langsdor (*Wetterauisches Journal*, P. I, p. 254,) first made known this very extraordinary physical phenomenon, which I prefer describing in latin: "Coriæcorum gens, in ora Asiæ septentrioni opposita, potum sibi excogitarit ex succo inebriante agariçi muscarii. Qui succus (æque ut asparagorum), vel per humanum corpus transfusus, temulentiam nihilominus facit. Quare gens misera et inops, quo rarius mentis sit suæ, propriam urinam bibit identidem: continuoque mingens rursusque hauriens eundem succum (dicas, ne ulla in parte mundi desit ebrietas), pauculis agaricis producere in diem quantum temulentiam potest."

lancha was laden with cacao, and carried on a contraband trade with the island of Trinidad. For this reason the proprietor thought we had nothing to fear from the enemy's vessels, which then blocked up all the Spanish ports. We embarked our collections of plants, our instruments, and our monkeys; and, the weather being delightful, we hoped to make a very short passage from the mouth of the Rio Neveri to Cumana: but we had scarcely reached the narrow channel between the continent and the rocky isles of Borracha and the Chimanas, when, to our great surprise, we met with an armed boat, which, hailing us at a great distance, fired some musket-shot at us. The boat belonged to a privateer of Halifax; and I recognized among the sailors a Prussian, a native of Memel, by his physiognomy and his accent. I had found no opportunity, since my arrival in America, of speaking my native language, and I could have wished to have used it on a less unpleasant occasion. Our protestations were without effect: we were carried on board the privateer, and the captain, affecting not to recognize the passports delivered by the governor of Trinidad for the illicit trade, declared, that we were lawful prize. Being a little in the habit of speaking English, I entered into a negotiation with the captain, not to be taken to Nova Scotia, but to be set on shore on the

neighbouring coast. While I endeavoured in the cabin to defend my own rights, and those of the proprietor, I heard a noise upon the deck. Something was whispered to the captain, who left us in consternation. Happily for us, an English sloop of war, the Hawk, was cruising in those parts, and had made signals to the captain to bring to; which he not being prompt to obey, a gun was fired from the sloop, and a midshipman sent on board our vessel. He was a polite young man, and gave me hopes, that the boat, laden with cacao, would be given up, and that on the following day we might pursue our voyage. In the meantime he invited me to accompany him on board the sloop, assuring me, that his commander, captain John Garnier, of the royal navy, would furnish me with better accommodation for the night, than I should find in the vessel from Halifax.

I accepted these obliging offers, and was received with the utmost kindness by captain Garnier, who had made the voyage to the north-west coast of America with Vancouver, and who appeared to be highly interested in all I related to him of the great cataracts of Atures and Maypure, the bifurcation of the Oroonoko, and its communication with the Amazon. He named to me several of his officers, who had been with lord Macartney in China. I had not for a year enjoyed the society of so many well-informed

persons. They had learnt from the English newspapers the object of my enterprise. I was treated with great confidence, and the commander gave me up his own stateroom. They gave me at parting the astronomical Ephemerides for the years which I had not been able to procure in France or Spain. I owe to captain Garnier the observations I made on the satellites beyond the equator, and feel it a duty to record here the gratitude I feel for his kind offices. Coming from the forests of Cassiquiare, and having been confined during whole months to the narrow circle of missionary life, we felt a soothing gratification at meeting for the first time with men, who had sailed round the world, and enlarged their ideas by the view of so varied a spectacle. I quitted the English vessel with impressions, which are not yet effaced from my remembrance, and which led me to cherish still more the career I had chosen.

We continued our passage on the following day, and were surprised at the depth of the channels between the Caraccas Islands, where the sloop manœuvred, almost touching the rocks. How much do these calcareous islets, of which the form and direction recal to mind the great catastrophe that separated them from the main land, differ in their aspect from the volcanic archipelago on the north of Lancerota*,

* See above, vol. i, p. 95.

where the hills of basalt seem to have been lifted up from the bottom of the sea! The frequency of the pelicans, which are larger than our swans, and of flamingoes, which fished in the nooks, or harassed the pelicans in order to seize their prey, indicated our approach to the coast of Cumana. It is curious to observe at sunrise how the sea-birds suddenly appear, and animate the landscape, reminding us, in the most solitary scenes, of the activity of our cities at the dawn of day. We reached at nine in the morning the gulf of Cariaco, which serves as a roadstead to the town of Cumana. The hill, crowned by the castle of St. Antonio, stood prominent from it's whiteness on the dark curtain of the inland mountains. We recognized with pleasure the shore, where we had culled the first plants of America, and where, some months later, Mr. Bonpland had been in such danger. Among the cactuses, that rise in columns and candelabras twenty feet high, appear the Indian huts of the Guaykeries. Every part of the landscape was known to us; the forest of cactus, the scattered huts, and that enormous ceiba, beneath which we loved to bathe at the approach of night. Our friends at Cumana came out to meet us; men of all casts, whom our frequent herborizations had brought into contact with us, expressed still greater joy, as a report of our death on the banks of the Oroonoko had been

current for several months. These gloomy reports had arisen either from the severe illness of Mr. Bonpland, or from our boat being nearly lost in a gust of wind above the mission of Uruana.

We hastened to visit the governor, don Vicente Emparan, whose recommendations and constant solicitude had been so useful to us during the long journey we had just terminated. He procured a house for us in the centre of the town*, perhaps too lofty in a country exposed to violent earthquakes, but extremely convenient for our instruments. We enjoyed from it's terraces a majestic view of the sea, the isthmus of Araya, and the archipelago of the isles of Carracas, Picuita, and Borracha. The port of Cumana was every day more strictly blockaded, and the vain expectation of Spanish packets retained us two months and a half longer in that place. We were often tempted to go to the Danish islands, enjoying a happy neutrality; but feared that, if we left the Spanish colonies,

* *Casa de don Pasqual Martinez*, on the north-east of the great square, near which I had made observations from July the 28th to November the 17th, 1799. All the astronomical observations, and those of mirage (vol. iii, p. 542), which are posterior to August the 29th, 1800, were made in the house of don Martinez. I relate these circumstances, because they may be interesting at some future period to those, who may wish to examine the precision of my labours

we might find some obstacles to our return. With the ample permissions, which in a moment of favour had been granted to us, nothing was to be hazarded, that might displease the local authorities. We employed our time in completing the Flora of Cumana, geognostically examining the eastern part of the peninsula of Araya, and observing a considerable number of eclipses of satellites, which confirmed the longitude of the place already obtained by other means. We also made experiments on the extraordinary refractions, on evaporation, and on atmospheric electricity.

The live animals which we had brought from the Oronoko were objects of great curiosity to the inhabitants of Cumana. The capuchin of the Esmeralda (*simia chiropotes*), which so much resembles man in the expression of it's physiognomy ; and the sleeping monkey (*simia trivirgata*), which is the type of a new groupe ; had never yet been seen on that coast. We destined them for the menagery of the Garden of Plants at Paris. The arrival of a French squadron, which had failed in an attack upon Curassao, having furnished us unexpectedly with an excellent opportunity for sending them to Guadaloupe, general Jeannet, and the commissary Bresseau, agent of the executive power at the Antilles, promised to take on themselves this commission. The monkeys and birds died

at Guadaloupe, but fortunately the skin of the simia chiropotes, which exists no where else in Europe, was sent a few years ago to the Garden of Plants; where the *couxio* (simia satanas), and the stentor or alouate of the steppes of Caraccas (simia ursina), of which I have given the figures in my *Recueil de Zoologie et d'Anatomie comparée*, had been already received. The arrival of so great a number of military Frenchmen, and the manifestation of political and religious opinions, that were not altogether conformable to those by which mother-countries think to confirm their authority, excited a singular agitation in the population of Cumana. The governor treated the French authorities with those forms of civility, which the intimate connexion, that subsisted at that period between France and Spain, prescribed. In the streets the mulattoes crowded round the agent of the Directory, whose dress was rich and theatrical; but as men with a white skin inquired also with indiscreet curiosity, whenever they could make themselves understood, concerning the degree of influence granted by the republic to the planters in the government of Guadaloupe, the king's officers redoubled their zeal in furnishing provision for the little squadron. Strangers, who boasted that they were free, appeared to these as troublesome guests; and I saw that in a country, of which the growing prosperity depended on

clandestine communications with the islands, and on a freedom of trade forced from the ministry, the European Spaniards were proud of the antique wisdom of the code of laws (*leyes de Indias*), that permitted the entrance of foreign vessels into their ports only in extreme cases of want or distress. I have dwelt on these contrasts between the restless desires of the planters, and the mistrusting immobility of the governors, because they throw some light on the great political events, which, long prepared, have at length separated Spain from it's colonies, or, as we might perhaps say with more precision, from it's provinces beyond sea.

We again passed some agreeable days, from the third to the fifth of November, at the peninsula of Araya, situate beyond the gulf of Cariaco, opposite to Cumana, and of which I have already described the pearls*, the sulphurous deposits, and the submarine springs of liquid and colourless petroleum. We were informed, that the Indians carried to the town from time to time considerable quantities of *native alum*, found in the neighbouring mountains. The specimens which were shown to us sufficiently indicated, that it was neither alunite †, similar to the rock of Tolfa and Piombino, nor those capillary and silky salts of alkaline sulphat of alumin and mag-

* Vol. ii, p. 239—299.

† *Alaunstein*, alum stone.

nesia, that line the clefts and cavities of rocks, but real masses of native alum, with a conchoid or imperfectly lamellar fracture. We were led to hope, that we should find the *mine of alum* in the slaty cordillera of Maniquarez, and so new a geognostic phenomenon was calculated to fix all our attention. Juan Gonzalez, an ecclesiastic, and the treasurer, don Manuel Navarrete, whose counsels had been useful to us from our first arrival on this coast, accompanied us in our little excursion. We disembarked near Cape Caney, and again visited the ancient saltpit, converted into a lake by the irruption of the sea, the fine ruins of the castle of Araya, and the calcareous mountain of Barigon, which, from its steepness on the western side, is somewhat difficult of access. Muriatiferous clay mixed with bitumen and lenticular gypsum, and sometimes passing to a darkish brown clay, destitute of salt, is a formation widely spread in this peninsula, in the island of Margareta, and on the opposite continent, near the castle of St. Antonio of Cumana. It is even very probable, that the existence of this formation has contributed to those ruptures and rents in the ground, which strike the geologist when he is placed on one of the eminences of the peninsula of Araya. The cordillera of this peninsula, composed of micaceous slate and clayslate, is separated on the north from the chain of mountains of the island

of Margarettas, which are of a similar composition, by the channel of Cubagua; and toward the south, from the lofty calcareous chain of the continent, by the gulf of Cariaco. The whole intermediate space appears to have been filled heretofore with muriatiferous clay; and it is no doubt the continual erosions of the ocean, that have removed this formation, and converted the plain first into lakes, then into gulfs, and finally into navigable channels. The account of what has passed in the most modern times at the foot of the castle of Araya, on the irruption of the sea into the ancient salt-pit, the form of the lagoon of Chacopata, and a lake four leagues in length, which cuts the Island of Margarettas nearly into two parts, furnish evident proofs of these successive erosions. In the singular configuration of the coasts, in the Morro of Chacopata; in the little islands of the Caribbees, the Lobos, and Tunal; in the great island of Coche, and the capes of Carnero and Mangliers; the remains of an isthmus* still seem to appear, which, stretching from north to south, joined heretofore the peninsula of Araya to the island of Margarettas. In this last island a neck of very low land, three thousand toises long, and less than two hundred toises broad, alone conceals

* The map *de la Isla Margarita y de sus canales*, published by Mr. Fidalgo in 1816, indicates very clearly these geognostic relations.

on the northern sides the two hilly groupés, known by the names of la Vega de San Juan, and of Macanao. The *Laguna grande* of Margareta has a very narrow opening toward the south, and small boats pass *arastrados*, that is by a *portage*, over the neck of land or northern dyke. Though the waters on these shores seem at present to recede from the continent, it is notwithstanding very probable, that in the lapse of ages, either by an earthquake, or by a sudden intumescence of the ocean, the long island of Margareta will be divided into two rocky islands of a trapezoidal form.

On climbing up the Cerro del Barigon, we repeated the experiments made at the Oroonoko, on the difference of temperature of the air and the decomposed rock. The temperature of the former was only 27° cent., toward eleven in the morning, on account of the effect of the breeze ; while that of the latter rose to 49·6°. The sap that rises in the *candelabra* cactuses (*cactus quadrangularis*) was from 38° to 41°. This heat was shown by a thermometer, the ball of which I placed within the fleshy and succulent stem of the cactus. This interior temperature of a plant is composed of that of the sand in which it's roots are fixed, and that of the external air modified by the state of the surface of the stem exposed to the rays of the Sun, it's evaporation, and the conducting power of the

wood. It is consequently the effect of very complicated causes. The limestone of Barigon, which makes a part of the great formation of sandstone or calcareous breccia of Cumana*, is filled with fossil shells in as perfect preservation as those of other tertiary limestones in France and Italy. We detached some blocks for the cabinet of the King at Madrid, containing oysters of eight inches in diameter, pectens, venuses, and lithophyte polypi. I recommend to naturalists better versed in the knowledge of fossils than I was at that period, to examine with care this mountainous coast, which is easy of access to European vessels in their way to Cumana, Guayra, or Curassao. It would be curious to discover whether any of these shells, and these species of petrified zoophytes, still inhabit the sea of the West Indies, as it appeared to Mr. Bonpland, and as is the case in the island of Timor, and perhaps in Guadaloupe.

We set sail the 4th of November, at one in the morning, in search of the mine of native alum. I took with me the timekeeper, and my large Dollond telescope, to observe at the *Laguna chica*, east of the village of Maniquarez, the immersion of the first satellite of Jupiter; this design however was not accomplished, contrary winds having prevented our arrival before

* Vol. i, p. 262; Vol. iii, p. 10.

daylight. The spectacle of the phosphorescence of the ocean, embellished by the sports of the porpoises which surrounded our canoe, could alone compensate for this delay. We again passed those spots, where springs of petroleum gush from micaslate* at the bottom of the sea, and the smell of which is perceived from afar. When we recollect, that farther to the east, near Cariaco, the hot† and submarine waters are sufficiently abundant to change the temperature of the gulf at its surface, we cannot doubt, that the petroleum is the effect of a distillation at an immense depth, issuing from those primitive rocks, beneath which lies the focus of all volcanic commotions.

The *Laguna chica* is a cove surrounded by perpendicular mountains, and connected with the gulf of Cariaco only by a narrow channel twenty-five fathoms deep. It seems, like the fine port of Acapulco, to have been formed by the effect of an earthquake. A beach shows, that the sea here retires from the land, as it

* Vol. ii, p. 290. The petroleum of the Caraccas islands, and that of Buen Pastor, of which I have spoken above (vol. iii, p. 186; vol. ii, p. 51), issue from secondary formations. Is not this a direct proof of the communication of the crevices that traverse the micaslate, limestone, and clay, lying on each other? I was also assured, that there is a spring of petroleum to the west of Maniquarez, in the inland.

† Vol. iii, p. 199.

does on the opposite coast of Cumana. The peninsula of Araya, which narrows between the capes Mero and las Minas to one thousand four hundred toises broad, is a little more than four thousand near the *Laguna chica*, reckoning from one sea to the other. We had to cross this inconsiderable distance in order to find the native alum, and reach the cape called the *Punta de Chuparuparu*. The road is difficult only because no path is traced; and between precipices of some depth you are obliged to step over ridges of bare rock, the strata of which are much inclined. The culminant point is nearly two hundred and twenty toises high; but the mountains, as it often happens in a rocky isthmus, display very singular forms. The *Tetas* of Chacopata and Cariaco, halfway between the *Laguna chica* and the town of Cariaco, are real peaks, which appear isolated when seen from the platform of the castle of Cumana. The vegetable earth in this country reaches only thirty toises above the level of the sea. Sometimes there is no rain during fifteen months*; if, however, a few drops fall immediately after the flowering of the melons and gourds, they yield fruits that weigh from sixty to seventy pounds, notwithstanding the apparent dryness of the air. I say the apparent dryness, for my

* Vol. iii, p. 204.

hygrometric observations prove, that the atmosphere of Cumana and Araya contains near nine tenths of the quantity of watery vapours necessary to it's perfect saturation. It is this air, at once hot and humid, that nourishes the *vegetable fountains*, the cucurbitaceous plants, the agaves and melocactuses half-buried in the sand. When we visited the peninsula the preceding year, there was a dreadful scarcity of water; the goats, wanting grass, died by hundreds. During our stay at the Oroonoko, the order of the seasons seemed to be entirely changed. At Araya, Cochen, and even in the island of Margareta, it had rained abundantly; and the remembrance of those showers occupied the imagination of the inhabitants, as a fall of aërolites would that of the naturalists of Europe.

The Indian who was our guide scarcely knew in what direction we should find the ore of alum; he was ignorant of it's real situation. This ignorance of localities characterizes here almost all the guides, who are chosen among the most indolent class of the people. We wandered for eight or nine hours, among rocks totally bare of vegetation. The micaceous slate passes sometimes to clayslate of a darkish gray. I was again struck by the extreme regularity in the direction and inclination of the strata. They run north 50° east, inclining from 60° to 70° to the north west. This is the general direction,

which I had observed in the gneiss-granite of Caraccas and the Oroonoko, in the hornblende slates of Angostura, and even in the greater part of the secondary rocks we had just examined. The beds, on a vast extent of land, make the same angle with the meridian of the place; they present a parallelism (or rather a *loxodromism*), which may be considered as one of the great geognostic laws susceptible of being verified by precise measures. In advancing toward cape Chuparuparu, the size of the veins of quartz, that cross the micaslate, increased. We found some that were from one to two toises broad, full of small fasciculated crystals of rutile-titanite. We sought in vain for cyanite, which we had discovered in some blocks near Maniquarez. Farther on, the micaslate furnishes not veins, but little beds of graphite or carburetted iron. They are from two to three inches thick, and have precisely the same direction and inclination as the rock. Graphite, in primitive soils, marks the first appearance of carbon on the globe, that of carbon uncombined with hydrogen. It is anterior to the period when the surface of the earth became covered with monocotyledonous plants. We enjoyed from the height of those wild mountains a majestic view of the island of Margareta. Two groups of mountains, which we have already mentioned, those of Macanao, and la Vega de San Juan, rise from the bosom

of the waters. The capital of the island, la Asuncion*, the port of Pampatar, and the villages of Pueblo de la Mar, Pueblo del Norte, and San Juan, belong to the second and most easterly of these groups. The western group, the Macanao, is almost entirely uninhabited. The isthmus, that divides these large masses of micaslate, was scarcely visible; it appeared disfigured by the effect of the *mirage*, and we recognized this intermediate part, cut by the *Laguna grande*, only by two small hills†, in the form of a sugarloaf, in the meridian of the Punta de Piedras. Nearer, we look down on the small desert archipelago of the four Morros del Tunal, the Caribbee, and the Lobos islands.

After many vain searches, we at length found, before we descended to the northern coast of the peninsula of Araya, in a ravine of very difficult access (*aroyo del Robalo*), the mineral which had been shown to us at Cumana. The micaslate changed suddenly into carburetted and shining clayslate. It was an ampelite; and the waters (for there are small springs in those parts, and some have recently been discovered near the village of Maniquarez) were impregnated with yellow oxyd of iron, and had a styptic taste. We found the sides of the neighbour-

* Lat. $11^{\circ} 0' 30''$; long. $0^{\circ} 19'$ east of the meridian of Cumana.

† Lat. $10^{\circ} 57'$; long. $0^{\circ} 3' 30''$ east of Cumana.

ing rocks lined with capillary sulphat of alumin in effervescence ; and real beds, two inches thick, full of native alum, stretched as far as the eye could reach in the clayslate. The alum is grayish white, somewhat dull at the exterior, and of an almost glassy lustre within. It's fracture is not fibrous, but imperfectly conchoid. It is hemidiaphanous, when it's fragments are thin ; and has a sweetish and astringent taste, without any bitter mixture. I proposed to myself the question even on the spot, whether this alum, so pure, and filling beds in the clayslate without leaving the smallest void, be of a contemporary formation with the rock ; or must be admitted to be of a recent, and in some sort secondary origin, like the muriat of soda, found sometimes in small veins, where strongly concentrated springs traverse beds of gypsum or clay. Nothing in these places seems to indicate a mode of formation, which may be renewed in our days. The slaty rock exhibits no open cleft ; and particularly none is found parallel to the direction of the slates. It may also be inquired, whether this aluminous slate be a transition formation lying on the primitive micaslate of Araya, or arise merely from a change of composition and texture in the beds of micaslate. I lean toward the latter proposition ; for the transition is progressive, and the argillaceous slate (*thonschiefer*) and micaslate appear to me to constitute here

but one sole formation. The presence of cyanite, rutile-titanite, and garnets, and the absence of lydianstone, and all fragmentary or arenaceous rocks, seem to characterize the formation we describe as primitive. It is asserted, that even in Europe ampelite and greenstone are found, though rarely, in slates anterior to transition-slate.

When, in 1785, after an earthquake, a great rocky mass was broken off in the Aroyo del Robalo, the Guaykeries of los Serritos collected fragments of alum five or six inches in diameter, extremely pure and transparent. It was sold in my time at Cumana to the dyers and shoemakers, at the price of two reals (one quarter of a piastre) a pound, while alum from Spain cost twelve reals. This difference of price was much more the effect of prejudice, and the shackles of trade, than of the inferior quality of the alum of the country, which is used without undergoing any purification. It is also found in the chain of micaslate and clayslate on the north-west coast of the island of Trinidad, at la Margareta, and near cape Chuparuparu, north of the Cerro del Destiladero*. The Indians, naturally addicted to

* Another place was indicated to us, west of Bordones, the Puerto Escondido. But that coast appeared to me to be wholly calcareous; and I cannot conceive where could be the situation of ampelite and native alum on this point. Was it to be found in the beds of slaty clay, that alternate with

concealment, are by no means inclined to make known the spots, whence they obtain native alum; but this must be abundant, for I have seen very considerable quantities in their possession at a time. It would be of importance to the government of Venezuela, to establish regular works, either of the ore we have just described, or in the aluminous slate that accompanies it. The latter might be roasted, lixiviated, and concentrated (by *graduation*) by the fervent Sun of the tropics.

South America at present receives it's alum from Europe, as Europe in it's turn received it from the natives of Asia till the fifteenth century. Mineralogists, before my travels, knew no other substances, which, without addition, calcined or not calcined, could directly yield alum (sulphat of alumin and potash), except rocks of trachytic formation, and small veins traversing beds of lignite and bituminous wood. Both these substances, of so different an origin, contain all that constitutes alum, that is to say, alumin, sulphuric acid, and potash. The ores of Tolfa, Milo, and Nipoligo; those of Montione, in which silica does not accompany the alumin; the siliceous breccia of Mont-Dore, so well de-

the alpine limestone of Cumanacoa? Vol. iii, p. 76. Fibrous alum is found in Europe only in formations posterior to those of transition, in lignites, and other tertiary formations that belong to the lignites.

scribed by Mr. Cordier, which contains sulphur in it's cavities; the alumiferous rocks of Parad and Beregh in Hungary, which belong also to trachytic and pumice conglomerates; are no doubt owing to the penetrating of sulphurous acid vapours*. They are the products of a feeble and prolonged volcanic action, as may be easily ascertained in the solfaterras of Puzzuoli and the Peak of Teneriffe. The alumite of Tolfa, which, since my return to Europe, I examined conjointly with Gay-Lussac on the spot, has, by it's oryctognostic characters and it's chemical composition, a considerable affinity to compact feldspar†, which constitutes the basis of so many trachytes and transition porphyries. It is a siliciferous subsulphat of alumin and potash, a compact feldspar, with the addition of sulphuric acid completely formed in it. The waters circulating in these alumiferous rocks of volcanic

* Gay-Lussac, in the *Annales de Chimie* (old series), Tom. 55, p. 266. Descotils in the *Annales des Mines*, 1816, p. 374. Cordier, in the *Annales de Chimie et de Physique*, Tom. 9, p. 71—88. Beudant, *Voyage en Hongrie*, tom. 3, p. 446—471.

† This feldspar contains, according to Klaproth, more silica than the alumite of Tolfa. The quantity of potash is the same, but three times less than in common (lamellar) and vitreous feldspars. We see however, on comparing the analyses of Klaproth and Vauquelin, that the relative proportions of silica and alumin vary much in different specimens obtained from the mine of Tolfa.

origin do not, however, deposit masses of native alum; to yield which the rocks have need of torrefaction. I know not of any deposits analogous to those I brought from Cumana; for the capillary and fibrous masses found in veins traversing the beds of lignites (banks of the Egra, between Saatz and Commothau in Bohemia *), or efflorescing in cavities (Freienwalde, in Brandenburg; Segario in Sardinia), are impure salts, often destitute of potash, mixed with sulphats of ammonia and magnesia. A slow decomposition of the pyrites, that act perhaps as so many little *galvanic piles*, renders the waters alumiferous, that circulate across the bituminous lignites and carburetted clays †. These waters, in contact with carbonat of lime, even give rise to the deposits of subsulphat of alumin (destitute of potash) which is formed near Halle, and was formerly believed erroneously to be pure alumin, belonging, like the porcelain earth

* *Feder-alaun, haarsalz, mehliges and stängliges alaun* of Freienwalde, Tcherning, &c. (*Klaproth, Beiträge*, Tom. i, p. 311; Tom. iii, p. 102, *Ficinus*, in the *Schriften der Dresdener Gesellschaft fuer Mineralogie*, Tom. i, p. 266; Tom. ii, p. 232). From what formation is the native alum drawn, which the Goubanians carry to Syena from the interior of Africa? (*Decade Egypt.* Tom. iii, p. 85). I regret, that I am not able, at a distance from my own collections, to determine the quantity of potash, which the native alum of Robalo contains.

† *Braunkohle and Alaunerde.*

(kaolin) of Morl, to porphyry of red sandstone. Analogous chemical actions may take place in primitive and transition slates, as well as in tertiary formations. All slates, and this fact is very important, contain near five per cent of potash, sulphuret of iron, peroxid of iron, carbon, &c. The contact of so many humected heterogeneous substances must necessarily lead them to a change of state and composition. The efflorescent salts, that abundantly cover the aluminous slates of Robalo, indicate how much these chemical effects are favoured by the high temperature of the climate ; but, I repeat, in a rock where there are no crevices, no vacuities parallel to the direction and inclination of the strata, native alum, hemidiaphanous and of conchoid fracture, completely filling it's *place* (it's beds), must be regarded as being of the same age with the rock in which it is contained. The term *contemporary formation* is here taken in the sense attached to it by geognosts, in speaking of beds of quartz in *clayslate*, granular limestone in *micaslate*, or feldspar in *gneis*.

After having for a long time wandered over barren scenes, amid rocks entirely destitute of vegetation, the eye reposed with pleasure on tufts of malpighia and croton, which we found in descending toward the coast. These arborescent crotons were of two new species *,

* *Croton argyrophyllus*, and *c. marginatus*.

very remarkable for their form, and peculiar to the peninsula of Araya. We arrived too late at the *Laguna chica*, to visit another rock farther east, and celebrated by the name of the *Laguna grande*, or *del Obispo**. We contented ourselves with admiring it from the height of the mountains, that command the view; and, excepting the ports of Ferrol and Acapulco, there is perhaps none of a more extraordinary configuration. It is an inland gulf two miles and a half long from east to west, and one mile broad. The rocks of micaslate, that form the entrance of the port, leave a free passage only two hundred and fifty toises broad. The water is every where from fifteen to twenty-five fathoms deep. It is probable, that the government of Cumana will one day take advantage of the possession of this inland gulf, and of that of Mochima †, eight sea leagues east of the bad road of Nueva Barcelona. The family of Mr. Navarete waited for us with impatience on the beach; and, though our boat carried a large sail, we did not arrive at Maniquarez before night.

We prolonged our stay at Cumana but a

* According to Mr. Fidalgo, lat. $10^{\circ} 35'$, long. $0^{\circ} 7' 50''$ east of Cumana. See above, vol. iii, p. 21.

† This is a long narrow gulf, three miles from north to south, similar to the *fiords* of Norway. Lat. at the entrance $10^{\circ} 23' 45''$; long. $10'$ west of Cumana, and $3'$ west of Puerto Escondido.

fortnight. Having lost all hope of the arrival of a packet from Cumana, we availed ourselves of an American vessel, laden at Nueva Barcelona with salt provision for the Isle of Cuba. We had now passed sixteen months on this coast, and in the interior of Venezuela. Although we had still more than fifty thousand francs left in bills of exchange on the first houses at the Havannah, we should have felt a very distressing want of funds, if the governor of Cumana had not made us all the advances we wished. The delicacy of Mr. d'Emparan's conduct toward strangers, who were entirely unknown to him, claims the highest praise, and the warmest gratitude. I mention these personal incidents, in order to warn travellers not to trust too much to the communications between the different colonies of the same country. In the state of commerce at Cumana and Caraccas in the year 1799, it would have been easier to make use of a draught upon Cadiz or London, than upon Carthagena, the Havannah, or Vera Cruz. We parted from our friends at Cumana on the 16th of November, to make the passage for the third time across the gulf of Cariaco to Nueva Barcelona. The night was cool, and delicious. It was not without emotion, that we saw for the last time the disk of the Moon illuminating the summit of the cocoa-trees, that surround the

banks of the Manzanares. Our eyes remained long fixed on that whitish coast, where once only we had to complain of our fellow men. The breeze was strong, and in less than six hours we anchored near the Morro of Nueva Barcelona, where the vessel which was to take us to the Havannah was ready to set sail.

CHAPTER XXVI.

*Political state of the Provinces of Venezuela.--
Extent of Territory.--Population.--Natural
Productions.--Exterior Commerce.--Communi-
cations between the different Provinces, that
compose the Republic of Columbia.*

BEFORE I quit the coasts of Terra Firma, and point out to the reader the political importance of Cuba, the largest of the West India islands, I shall collect into one point of view whatever may lead to a just appreciation of the future relations of commercial Europe with the United Provinces of Venezuela. In publishing, soon after my return to Germany, the *Essai Politique sur la Nouvelle-Espagne*, I made known at the same time a part of the materials, which I possess on the territorial riches of South America. This comparative view of the population, agriculture, and commerce, of all the Spanish colonies, was formed at a period, when the progress of civilization was shackled by the imperfection of social institutions, the prohibitory system, and

other fatal errors in the science of government. Since I developed the immense resources, which the people of both Americas, enjoying national liberty, might find in their own position and their relations with commercial Europe and Asia, one of those great revolutions, which from time to time agitate the human race, has changed the state of society in the vast regions through which I passed. The continental part of the New World is at present in some sort divided between three nations of European origin; one, the most powerful, is of Germanic race; the two others belong by their language, their literature, and their manners, to Latin Europe. Those parts of the ancient world, which project farthest toward the west, the Iberian Peninsula and the British Islands, are those of which the colonies are most extensive; but four thousand leagues of coast, inhabited solely by the descendants of Spaniards and Portuguese, attest the superiority, which in the fifteenth and sixteenth centuries the peninsular nations had acquired by their maritime expeditions over the navigators of other countries. It may be asserted, that their languages, which are spread from California as far as the Rio de la Plata, and on the back of the Cordilleras as well as in the forests of the Amazon, are monuments of national glory, that will survive every political revolution.

The inhabitants of Spanish and Portuguese

America form together a population twice as numerous as that of English race. The French, Dutch, and Danish possessions of the new continent are of small extent; but, to complete the general view of the nations, which may have an influence on the destiny of the other hemisphere, we ought not to forget the colonies of Scandinavian origin, who are trying to form settlements from the peninsula of Alashka as far as California; and the free Africans of Hayti, who have accomplished the prediction of the Milanese traveller Benzoni in 1545. The situation of the Africans, in an island more than three times as big as Sicily, in the middle of the Mediterranean of the West Indies, augments their political importance. Every friend of humanity prays for the developement of a civilization, which advances in so calm and unexpected a manner. Russian America hitherto less resembles an agricultural colony, than the factories which the Europeans have established on the coast of Africa, to the great misfortune of the natives, presenting only military posts, stations of fishermen, and Siberian hunters. It is no doubt a striking phenomenon, to find the rites of the Greek church established in one part of America; and to see two nations, which inhabit the eastern and western extremities of Europe, the Russians and Spaniards, thus bordering on each other on a continent where they

arrived by opposite ways; but the almost savage state of the unpeopled coasts of Ochotsk and Kamtschatka, the want of resources furnished by the ports of Asia, and the barbarous system hitherto adopted in the Scandinavian colonies of the New World, are shackles that will hold them long in infancy. Hence it follows, that if in the researches of political economy we accustom ourselves to investigate only the mass, we cannot but admit, that the American continent is divided, properly speaking, solely between three great nations, of English, Spanish, and Portuguese race. The first of these three nations, the Angloamericans, is also, next to the English of Europe, that which covers with it's flag the greatest extent of sea. Without any distant colonies, it's commerce has acquired a growth attained in the ancient world by that nation alone, which communicated to North America it's language, the splendor of it's literature, it's love of labour, it's predilection for liberty, and a part of it's civil institutions.

The English and Portuguese colonists have peopled only the coasts opposite to Europe; the Castillians, on the contrary, from the beginning of the conquest, have passed over the chain of the Andes, and made settlements in the most western regions. There only, at Mexico, Cundinamarca, Quito, and Peru, they found traces of ancient civilization, agricultural nations, and

flourishing empires. This circumstance, together with the growth of the native mountain population, the almost exclusive possession of great metallic wealth, and the commercial relations established from the beginning of the sixteenth century with the Indian archipelago, have given a peculiar character to the Spanish possessions in equinoxial America. In the countries of the east, the people who fell into the hands of the English and Portuguese planters were wandering tribes, or hunters. Far from forming a portion of the agricultural and laborious population, as on the table land of Anahuac, at Guatemala, and in Upper Peru, they generally withdrew at the approach of the whites. The necessity of labour, the preference given to the cultivation of the sugar-cane, indigo, and cotton, the cupidity which often accompanies and degrades industry, gave birth to that infamous trade in Negroes, the consequences of which have been alike fatal to both worlds. Happily, in the continental part of Spanish America, the number of African slaves is so inconsiderable, that, compared with the servile population of Brazil, or with that of the southern part of the United States, it is found to be in the proportion of one to fourteen. The whole of the Spanish colonies, without excluding the islands of Cuba and Portorico, have not, on a surface which exceeds at least by a fifth that of

Europe, as many Negroes as the single state of Virginia. The Spanish Americans display in the union of New Spain and Guatemala the sole example in the torrid zone of a nation of eight millions of inhabitants governed according to European institutions and laws, cultivating at the same time sugar, cacao, wheat, and grapes, and having scarcely a slave torn from the land of Africa.

The population of the New Continent yet surpasses but little that of France or Germany. It doubles in the United States in twenty-three or twenty-five years; and at Mexico, even under the government of the mother country, it doubles in forty or forty-five years. Without indulging too flattering hopes of the future, it may be admitted, that in less than a century and a half the population of America will equal that of Europe. This noble rivalry in civilization, and the arts of industry and commerce, far from impoverishing the ancient continent, which has been so often prognosticated, at the expense of the new, will augment the wants of the consumer, the mass of productive labour, and the activity of exchange. No doubt after the great revolutions, which human societies undergo, the public fortune, which is the common patrimony of civilization, is found differently divided among the nations of the two worlds: but by degrees the equilibrium is restored; and it is a fatal, I had

almost said an impious prejudice, to consider the growing prosperity of any other part of our planet as a calamity for ancient Europe. The independance of the colonies will not contribute to isolate them from the old civilized nations, but will rather bring them closer. Commerce tends to unite what a jealous policy has long separated. It may be added, that it is the nature of civilization to go forward, without becoming extinct for this reason in the spot that gave it birth. It's progression from east to west, from Asia to Europe, proves nothing against this axiom. A clear light preserves the same splendor, even when it illumines a wider space. Intellectual cultivation, that fertile source of national wealth, communicates itself from step to step, and extends itself without being displaced. It's movement is not a migration: and if it appear such to us in the east, it is because barbarous hordes have seized upon Egypt, Asia Minor, and that Greece, heretofore free, the forsaken cradle of the civilization of our ancestors.

The barbarism of nations is the consequence of the oppression exercised either by interior despotism, or foreign conquest; and it is always accompanied by a progressive impoverishment, a diminution of the public fortune. Free and powerful institutions, adapted to the interests of all, remove these dangers; and the growing civilization of the world, the rivalship of labour,

and that of trade, are not the ruin of states, the welfare of which flows from a natural source. Productive and commercial Europe will profit from the new order of things in Spanish America, as it would profit by the increase of its consumption, from events that might put an end to barbarism in Greece, or the northern coast of Africa, and in other countries subjected to the tyranny of the Ottomans. What most menaces the prosperity of the ancient continent is the prolongation of those intestine struggles, which stop production, and diminish at the same time the number and wants of the consumers. This struggle, begun in Spanish America six years after my departure, is drawing gradually to an end. We shall soon see independent nations, ruled by very different forms of government, but united by the remembrance of a common origin, the uniformity of language, and the wants to which civilization gives rise, inhabit the two shores of the Atlantic. It may be said, that the immense progress of the art of navigation has narrowed the basin of the seas. The Atlantic Ocean already appears to us in the form of a narrow channel, which as little removes the New World from the commercial states of Europe, as the basin of the Mediterranean, in the infancy of navigation, removed the Greeks of Peloponnesus from those of Ionia, Sicily, and the Cyrenaïc region.

It appeared to me proper to state these general considerations on the future connection of the two continents, before I traced the political sketch of the provinces of Venezuela, of which I have made known the different races of men, the spontaneous and cultivated productions, the inequalities of the soil, and the interior communications. These provinces, governed till 1810 by a captain general residing at Caraccas, are now united to the ancient viceroyalty of New Grenada, or Santa Fé, by the name of the Republic of Columbia. I shall not anticipate the description, which I must give hereafter of New Grenada; but, in order to render my observations on the statistics of Venezuela more useful to those, who would judge of the political importance of the country, and the advantages it may offer to the trade of Europe, even in its present little advanced state of cultivation, I shall describe the *United Provinces of Venezuela* in their intimate relations with Cundinamarca, or New Grenada, and as forming part of the new state of Columbia. This sketch will necessarily comprehend five divisions; the extent, population, productions, trade, and public revenue. A part of the statements, which will serve to form this view, having been indicated in the preceding chapters, I shall be concise in noting the general results. Mr. Bonpland and I passed nearly three years in the country, which

now forms the territory of the republic of Columbia; sixteen months in Venezuela, and eighteen in New Grenada. We crossed the territory in it's whole extent; on one hand from the mountains of Paria as far as Emeraldal on the Upper Oroonoko, and San Carlo del Rio Negro, situate near the frontiers of Brazil; and on the other, from Rio Sinu and Carthagenas as far as the snowy summits of Quito, the port of Guayaquil on the coast of the Pacific ocean, and the banks of the Amazon in the province of Jaen de Bracamoros. So long a stay, and an expedition of one thousand three hundred sea leagues in the interior of the country, of which more than six hundred and fifty were made by water, have furnished me with a pretty exact knowledge of local circumstances. I will not, however, flatter myself with having collected as numerous and certain statistical materials on Venezuela and New Grenada, as those which were afforded me by a much shorter stay in New Spain. We are less induced to discuss questions of political economy in countries merely agricultural, and which present several centres of authority, than where the concentrated civilization of a great capital, and the immense product of mines, accustom men to the commercial estimation of natural wealth. I found in official documents at Mexico and Peru a part of the statements, which I wished to procure. It was otherwise at

Quito, Santa Fé, and Caraccas, where an interest in statistical researches will be developed only through the enjoyment of an independent government. They who are accustomed to examine ciphers before they admit their truth know, that in newly founded free states delight is taken in exaggerating the increase of the public fortune; while in old colonies the list of evils, which are all attributed to the influence of the prohibitory system, is augmented. The people seem to avenge themselves of the mother country, when they exaggerate the stagnation of trade, and the slow progress of population.

I am not ignorant, that travellers, who have recently visited America, regard this progress as far more rapid than the numbers on which I have fixed in my statistical researches seem to indicate. For the year 1913 they promise one hundred and twelve millions of inhabitants in Mexico, of which they believe that the population is doubled every twenty-two years; and for the same epocha one hundred and forty millions in the United States*. These numbers, I confess, do not affright me from the motives, that would alarm the zealous disciples of the system of Malthus. Two or three hundred millions of men may very possibly find subsistence one day in the immense extent of the new continent

* *Robinson's Memoirs on the Mexican Revolution*, Vol. ii, p. 315.

between the lake of Nicaragua and lake Ontario. I admit, that the United States will contain above eighty millions of inhabitants a hundred years hence, allowing a progressive change in the period of doubling from twenty-five to thirty-five and forty years; but, notwithstanding the elements of prosperity to be found in equinoxial America, notwithstanding the wisdom, which I am willing to attribute simultaneously to the new republican governments formed on the south and on the north of the equator, I doubt whether the increase of the population in Venezuela, Spanish Guyana, New Grenada, and Mexico, can be in general so rapid as in the United States. The latter, situate entirely in the temperate zone, destitute of high chains of mountains, offer an immense extent of country of easy cultivation. The hordes of Indian hunters recede before the planters, whom they abhor, and the methodist missionaries, who oppose their taste for indolence and a vagabond life. The more fertile land of Spanish America produces indeed on the same surface a greater bulk of nutritive substances. No doubt on the table lands of the equinoxial region wheat yields annually from twenty to twenty-four for one; but Cordilleras furrowed by almost inaccessible crevices, bare and arid steppes, forests that resist both the axe and fire, and an atmosphere full of venomous insects, will long oppose powerful

obstacles to agriculture and industry. The most enterprising and robust planters cannot advance in the mountainous districts of Merida, Antioquia, and los Pastos, in the llanos of Venezuela and Guaviare, in the forests of Rio Magdalena, the Oroonoko, and the province of las Esmeraldas, west of Quito, as they have extended their agricultural conquests in the woody plains on the west of the Alleghanies, from the sources of the Ohio, the Tennessee, and the Alabama, as far as the banks of the Missouri and the Arkansas. In calling to mind the account of my voyage on the Oroonoko, we may appreciate the obstacles, which the force of nature opposes to the efforts of man in burning and humid climates. In Mexico, large extents of soil are destitute of springs; rains seldom fall, and the want of navigable rivers impedes communication. As the ancient native population is agricultural, and had been so long before the arrival of the Spaniards, the lands of more easy access and cultivation have already their proprietors. Fertile countries of vast extent, at the disposition of the first occupier, or ready to be sold in lots for the profit of the state, are much less common than is imagined in Europe. Hence it follows, that the progress of colonization cannot be every where as free and rapid in Spanish America, as it has been hitherto in the western provinces of the Angloamerican union. The population of

that union is composed wholly of whites, and of Negroes, who, torn from their country, or born in the New World, are become the instruments of the industry of the whites. In Mexico, Guatimala, Quito, and Peru, on the contrary, there exist in our day more than five millions and a half of natives of copper-coloured race, whose isolated position, partly forced and partly voluntary, attachment to ancient habits, and mistrustful inflexibility of character, will long prevent their participation in the progress of the public prosperity, notwithstanding the artifices employed to *disindianize* them.

I dwell on the differences between the free states of temperate and equinoxial America, to show, that the latter have to struggle with obstacles connected with their physical and moral situation; and to remind the reader, that the countries embellished by nature with the most varied and precious productions, are not always susceptible of an easy, rapid, and uniformly extended cultivation. If we investigate the limits, which the population may attain, as depending solely on the quantity of subsistence, that the land can produce, the most simple calculations would prove the preponderance of the communities established in the fine regions of the torrid zone; but political economy, or the positive science of government, distrusts ciphers and vain abstractions. We know, that

by the multiplication of one family only, a continent previously desert may reckon in the space of eight centuries more than eight millions of inhabitants ; and yet these estimations, founded on the hypothesis of a *constant doubling* in twenty-five or thirty years, are contradicted by the history of every country already advanced in civilization. The destinies, which await the free states of Spanish America, are too glorious, to stand in need of being embellished by illusions, and chimerical calculations.

AREA AND POPULATION.—To fix the attention of the reader on the political importance of the ancient *Capitania general of Venezuela*, I shall begin by comparing it with the great masses, in which the various nations of the New Continent are now grouped. It is by rising to more general views, that we may hope to throw some interest on the detail of those statistical data, which are the variable elements of national prosperity and power. Among the thirty-four millions of inhabitants spread over the vast surface of *continental America*, in which estimate the savage and native inhabitants are comprised, we distinguish, according to the *three preponderant races*, sixteen millions and a half in the possessions of the *Spanish Americans*, ten millions in those of the *Angloamericans*, and nearly four millions in those of the *Portuguese Americans*. The population of these three great divisions is,

in our days, in the proportion of 4, 2 $\frac{1}{2}$, 1; while the extent of surface, on which the population is spread, is, as the numbers 1.5, 0.7, 1. The *area* of the United States is nearly a fourth greater than that of Russia on the west of the Uralian mountains; and Spanish America is in the same proportion more extensive than the whole of Europe. The United States* contain five eighths of the population of the Spanish possessions, and yet their *area* is not one half so large. Brazil comprehends tracts of country so desert toward the west, that, in an extent only a third less than that of Spanish America, its population is in the proportion of one to four. The following table contains the results of an attempt, which I made conjointly with Mr. Mathieu, member of the Academy of Sciences and

* To avoid tiresome circumlocutions, I shall continue to designate in this work, notwithstanding the political changes which have taken place in the state of the colonies, the country inhabited by the *Spanish Americans*, by the denomination of *Spanish America*. I call the country of the *Angloamericans* the *United States*, without adding of *North America*, although other *United States* are formed in South America. It is embarrassing to talk of nations, who act a great part on the stage of the world, without having collective names. The term *American* can no longer be applied solely to the citizens of the United States of North America; and it were to be wished, that the nomenclature of the independant nations of the New Continent should be fixed in a manner at once convenient, harmonious, and precise.

of the *Bureau des longitudes*, to estimate by precise methods the extent of the surface of the various states of America. We made use of maps, on which the limits had been corrected, according to the statements published in my *Recueil d'Observations astronomiques*. Our scales were in general sufficiently large, not to neglect spaces from four to five leagues square. We observed this degree of precision, that we might not add the uncertainty of the measure of triangles, trapeziums, and the sinuosities of the coasts, to that of the uncertainty of geographical statements.

| GREAT POLITICAL DIVISIONS. | SURFACE in square leagues of 20 to an equinoxial degree. | POPULATION. (1823). |
|---|---|---|
| I. Possessions of the Spanish Americans. Mexico or New Spain . . . Guatimala Cuba and Portorico. Columbia { Venezuela { New Grenada { and Quito Peru Chili Buenos Ayres | 371,380 75,830 16,740 4,430 33,700 58,250 41,420 14,240 126,770 | 16,785000 6,800000 1,600000 800000 785000 2,000000 1,400000 1,100000 2,300000 |
| II. Possessions of the Portuguese Americans. (Brazil) | 256,990 | 4,000000 |
| III. Possessions of the Anglo-americans (United States) . . . | 174,300 | 10,220000 |

CHAPTER XXVI.

EXPLANATIONS.

I FOUND the whole extent of South America, taking for the limit the eastern extremity of the Province of Panama, to be 571,290 square leagues ; of which the Spanish part, that is Columbia (without the isthmus of Panama and the province of Veragua), Peru, Chili, and Buenos Ayres (without the Magellanic lands), comprise 271,774 square leagues ; the Portuguese possessions, 256,990 square leagues ; the English, Dutch, and French Guyana, 11,320 square leagues ; and the lands of Patagonia, south of Rio Negro, 31,206 square leagues. The following numbers, indicating great extents of surface, may serve as terms of comparison *. Europe, 304,700 square leagues ; Russian empire in Europe and Asia, 603,160 square leagues ; European part of the Russian empire, 138,116 square leagues ; United States of America, 174,310 square leagues. The whole of these estimates are made in square leagues of twenty to an equatorial degree, or 2853 toises. I have adopted this measure in the *Personal Narrative* of my voyage, because nautical leagues, of three miles each, would be more easily adopted uniformly, as a geographical measure, among the commercial nations of Spanish America, than the *leguas legales* and *leguas communes* of Spain, which are twenty-six and a half, and nineteen to a degree. In the *Political Essay on the*

* See note B, at the end of the 9th Book.

Kingdom of New Spain, the surfaces are indicated in square leagues of twenty-five to a degree, as they are for the most part in the statistical works published in France. I repeat these statements, because several modern authors, while they have copied the estimates of surfaces contained in the *Political Essay*, have confounded, in their reductions, the leagues of twenty-five to a degree with nautical and geographical leagues; a confusion as lamentable as that of the centigrade and octogesimal scales of the thermometer. By the side of an invariable element, that of the *area*, depending on the degree of precision of the maps which I constructed, I have placed a very uncertain element, that of population. The following statements will throw light on this subject, which may long have been reasonably called *plenum opus aleæ*. In the study of political economy, ciphers, like the elements of meteorology and astronomical tables, can only progressively acquire precision, and we must stop most frequently at *numbers within certain limits*.

A. POPULATION.

MEXICO. I believe I have proved in another place from positive data, that the population of the Viceroyalty of New Spain in 1804, including the *provincias internas* and Yucatan, but not the *capitania general* of Guatemala, contained at least 5,840,000 inhabitants, of which 2,500,000 are natives of copper-coloured race; 1,000,000 of Mexican Spaniards, and 75,000 Europeans. I even announced (*Essai politique*, Tom. i, p. 65—76), that the population in 1808 would be nearly 6,500,000, two or three fifths of it, or 3,250,000, being Indians. The intestine wars, which have long agitated the governments of Mexico, Vera Cruz, Valladolid, and Guanajuato, have no doubt retarded the progress of the annual increase of the Mexican population, which at the time of my stay in the country was probably more than 150,000 (*Essai pol.* tom. i, p. 62—64). The proportion of

births to the population appeared to be one to seventeen; and that of deaths one to thirty. In admitting for eighteen years only an increase of a million of inhabitants, I believe I have estimated high enough the effects of those popular commotions, which have interrupted the working of mines, commerce, and agriculture. Researches made in the country itself have recently proved, that the estimates I formed twelve years ago are not far from the truth. Don Fernando Navarro y Noriega has published at Mexico the results of an extensive inquiry into the number of *curatos y misiones* of Mexico; he estimates the population of the country in 1810 at 6,128,000. (*Catalogo de los curatos que tiene la Nueva España*, 1813, p. 38; and *Rispuesta de un Mexicano al n° 200 del Universal*, p. 7). The same author, enabled by his office in the finances (*Contador de los ramos de arbitrios*) to examine the statistic statements on the spot, thinks (*Memoria sobre la poblacion de Nueva España, Mexico 1814*, and *Semanario politico y literario de la Nueva España*, n°. 20, p. 94) that in 1810 the population of New Spain, without including the provinces of Guatemala, was composed of the following elements:

1,097,928 Europeans and American Spaniards.

3,676,281 Indians.

1,338,706 of mixed race.

4,229 secular ecclesiastics.

3,112 ecclesiastics of the regular clergy.

2,098 nuns.

6,122,354

I am inclined to believe, that New Spain has at present nearly seven millions of inhabitants, and this is also the opinion of a respectable prelate, the archbishop of Mexico, don Jose de Fonte, who has travelled through a considerable part of his diocese, and whom I had recently the honour of seeing again at Paris.

GUATIMALA. This country, which has been hitherto designated as a kingdom, comprises the four bishoprics of Guatimala, Leon de Nicaragua, Chiapa or Ciudad Real, and Comayagua or Honduras. A numbering made in 1778 by the secular government, which was kindly communicated to me by Mr. Del Barrio (deputed to the Cortes of Madrid before the declaration of the independence of Mexico), gave only a population of 797,214 inhabitants; but don Domingo Juarros, the learned author of the *Compendio de la historia de Guatemala*, published successively in 1809—1818, has proved, that this result is very inaccurate (vol. i, p. 9 and 91). The numberings made at the same period by order of the bishops gave above a third more. During my stay at Mexico, the population of Guatimala, where the Indians are extremely numerous, was computed from official documents at 1,200,000; and it is now estimated by persons, to whom the localities are well known, at two millions. Being always desirous of stopping at numbers erring on the deficient side, I have reckoned the population only at 1,600,000.

CUBA and PORTORICO. The population of the great island of Portorico is little known; it has much increased since the year 1807, when it was computed at 136,000 inhabitants, of which 17,500 were slaves. The census of the island of Cuba gave in 1811, as we have said above, 600,000 inhabitants, of which 212,000 were slaves. (*Documentos de que hasta ahora se compone el expediente sobre los negros de la isla de Cuba*, Madrid, 1817, p. 139.) In another official document much more recent (*Reclamacion hecha por los Representantes de Cuba contra la ley de aranceles*, Madrid, 1821, p. 6), the total population is computed at 630,980 souls.

COLUMBIA. The seven provinces, which heretofore formed the *Capitania general* of Caraccas, had, at the beginning of the 19th century, at the moment when the revolution burst forth, nearly 800,000 inhabitants, according to the ma-

terials which I collected. These materials are not a total enumeration made by the secular power, but partial estimates only, founded partly on the statements of the clergy and missionaries, and partly on considerations of the consumption, and the greater or less advanced state of cultivation. Persons employed in the government of Caraccas, and particularly a man well informed in financial matters, don Manuel Navarete, an officer of the royal treasury at Cumana, assisted me in this task. The period to which it goes up renders it highly interesting. It is a point from which the increase of the population since the acquisition of liberty and independence, may some day be estimated. This increase, we may presume, cannot be felt, till those fine countries are restored to internal tranquillity. Possibly at the time when this work appears, the population may be somewhat less than in 1800. The armies have not been numerous, but they have desolated the best cultivated countries on the coast, and the neighbouring valleys. The earthquake of the 26th of March, 1812 (*See* above, vol. iv, p. 12), the epidemic fevers that prevailed in 1818 (vol. v, p. 761), the arming of the blacks, so imprudently favoured by the royalist party, the emigration of many wealthy families to the West India islands, and a long stagnation of trade, have augmented the public misery.

Provinces of Cumana and Barcelona.....110,000 souls.

I am in possession of a numbering made in 1792, which is at least one sixth in error, and which gives 86,083 souls, of which 42,615 were Indians; namely, 27,787 *de doctrina*, or inhabitants of villages that have a vicar of the secular clergy, and 14,828 *de mission*, or governed by missionary monks. I compute in 1800 for the province of Cumana, or New Andalusia, 60,000: and for the province of Barcelona, 50,000.

Province of Caraccas..... 370,000

The valley of Caucagua and the savannahs of Ocumare were reckoned in 1801, to contain 30,000 ; the town of Caraccas, and the valleys of Chacao, Petare, Mariches, and los Teques, 60,000 ; Portocabello, Guayra, and the whole shore from cape Codera as far as Aroa, 25,000 ; the valleys of Aragua, 52,000 ; le Tuy, 20,000 ; the districts of Carora, Barquesimeto, Tocuyo, and Guanare, 54,000 ; S. Felipe, Nirgua, Aroa and the neighbouring plains, 34,000 ; the llanos of Calabozo, San Carlos, Araure, and San Juan Baptista del Pao, 40,000. These partial estimates, which comprise almost all the inhabited parts, yield a total of only 315,000.

Province of Coro..... 32,000

Province of Maracaybo (with Merida and Truxillo) 140,000

Province of Varinas 75,000

Province of Guayana 40,000

A numbering in 1780, the results of which I found in the archives of Angostura (Santo Tomè de la Nueva Guayana), gave 19,616 inhabitants; 1,479 whites, 16,499 Indians, 620 blacks, 1018 *pardos* and *zambos* (people of mixed race).

Island of Margaretta 18,000

Total..... 785,000

Perhaps, even at the period at which I stop, the population of the two provinces of Caraccas and Maracaybo, and that of the island of Margaretta (*Brown's Narrative*, 1819, p.118), were somewhat exaggerated; Mr. Depons, however, who had alike access to the returns made by the vicars to the bishops, estimates the province of Caraccas only, including the province of Varinas, at 500,000 (*Voyage à la Terre Ferme*, tom. i, p. 177). The villages are extremely po-

pulous in the provinces of Maracaybo, both around the lake, and in the mountains of Merida and Truxillo. Among the 780,000, or 800,000 inhabitants, which we may suppose in the *Capitania general* of Caraccas in 1800, there were probably nearly 120,000 Indians of pure race. The official documents * give 25,000 for the province of Cumana (15,000 of them for the missions of Caripe alone); 30,000 for the province of Barcelona (of which 24,700 are in the missions of Piritoo); 34,000 for the province of Guayana (that is, 17,000 in the missions of Carony, 7000 in that of the Oroonoko, and nearly 10,000 living in a state of independence in the Delta of the Oroonoko and in the forests). These statements suffice to prove, that the number of copper-coloured Indians in the *Capitania general* is neither 72,800 nor 280,000, as it has recently been erroneously asserted. (*Depons*, tom. i, p. 178; *Matte-Brun*, *Geogr.*, tom. v, p. 549). The first of these authors, who estimates the total population at only 728,000, instead of 800,000, has singularly exaggerated the number of slaves. He reckons 218,400 (tom. i, p. 241). This number is almost four times too great (*See* above, vol. iii, p. 433). According to partial estimates, made by three persons to whom the localities were well known, don Andres Bello, don Louis Lopez, and don Manuel Palacio Faxardo, in 1812, there existed 62,000 slaves at the utmost, of whom there were

10,000 at Caraccas, Chacao, Petare, Baruta, Mariches, Guarenas, Guatire, Antimano, La Vega, Los Teques, San Pedro, and Budare.

18,000 at Ocumare (las Sabanas), Yare, Santa Lucia, Santa Teresa, Marin, Caucagua, Capaya, Tapipa, Tacarigua, Mamporal, Panaquire, Rio Chico, Guapo, Cupira, and Curiepe.

5,600 at Guayos, San Mateo, Victoria, Cagua, Escobal, Turmero, Maracay, Guacara, Guigue, Valencia, Puerto Cabello, and San Diego.

* *See* note C., at the end of the 9th Book.

3,000 at Guayra, Choroni, Ocumare, Chuao, and Burburata.

4,000 at San Carlos, Nirgua, San Felipe, Llanos de Barquesimeto, Carora, Tocuyo, Araure, Ospinos, Guanare, Villa de Cura, San Sebastian, and Calabozo.

22,000 at Cumana, Nueva Barcelona, Varinas, Maracaybo, and in Spanish Guyana.

The number of Spanish Americans probably amounts only to 200,000; that of whites born in Europe, to 12,000; whence would result for the whole ancient *Capitania general* of Caraccas, the proportion of 0·51 mixed (mulattoes, zamboes, and mestizes), 0·25 Spanish Americans (creole whites), 0·15 Indians, 0·08 Negroes, and 0·01 Europeans.

With respect to the kingdom of New Grenada, I refer to the numberings of 1778, which gave 747,641 for the *audiencia* of Santa Fé; and 531,799 for that of Quito. Now, supposing only one seventh omitted, and adding only 0·018 of annual increase, we find in 1800, from the most moderate suppositions, above two millions. Mr. Caldas, well informed of the political state of his native country, reckoned three millions in 1808 (*Semanario de Santa-Fe*, No. 1, p. 2—4). But it is to be feared, that this learned writer greatly exaggerated the number of independent Indians. I find, after mature examination of the materials I possess, the population of the republic of Columbia to be 2,785,000. This estimate is less than that of the president of the congress, who, in the proclamation of the 10th of January, 1820, reckons 3 $\frac{1}{2}$ millions; and it is rather more than that which was officially published in the *Gazeta de Colombia* of the 10th of February, 1822, and which I know only from the journals of Buenos Ayres.

| DEPARTMENTS. | PROVINCES. | Population. |
|----------------|------------------|-------------|
| <i>Oronoko</i> | Cumana..... | 70,000 |
| | Barcelona | 44,000 |
| | Guayana | 45,000 |
| | Margaretta | 15,000 |
| | | <hr/> |
| | | 174,000 |

| | | | |
|------------------|---|-----------------|---------|
| <i>Venezuela</i> | { | Caraccas | 350,000 |
| | { | Varinas | 80,000 |
| | | | <hr/> |
| | | | 430,000 |
| <i>Sulia</i> | { | Coro | 30,000 |
| | { | Truxillo..... | 33,400 |
| | { | Merida | 50,000 |
| | { | Maracaybo | 48,700 |
| | | | <hr/> |
| | | | 162,100 |

These three departments form the ancient *Capitania general* of Caraccas, with a population of 766,100.

| | | | |
|---------------------|---|-------------------|---------|
| <i>Boyaca</i> | { | Tunja | 200,000 |
| | { | Socorro .. | 150,000 |
| | { | Pamplona | 75,000 |
| | { | Casanare | 19,000 |
| | | | <hr/> |
| | | | 444,000 |
| <i>Cundinamarca</i> | { | Bogota | 172,000 |
| | { | Antioquia..... | 104,000 |
| | { | Mariquita | 45,000 |
| | { | Neiva..... | 50,000 |
| | | | <hr/> |
| | | | 371,000 |
| <i>Cauca</i> | { | Popayan | 171,000 |
| | { | Choco | 22,000 |
| | | | <hr/> |
| | | | 193,000 |
| <i>Magdalena</i> | { | Cartagena | 170,000 |
| | { | Santa Marta | 62,000 |
| | { | Rio Hacha..... | 7,000 |
| | | | <hr/> |
| | | | 239,000 |

At the same period (1822), for two provinces of Columbia, the deputies of which were not then arrived at the Congress, were reckoned,

| | |
|---------------|--------|
| Panama | 50,000 |
| Veragua | 30,000 |
| <hr/> | |
| | 80,000 |

The departments of Boyaca, Cundinamarca, Cauca, and Magdalena, form, with Panama and Veragua, the ancient *audiencia of Santa-Fe*; that is, New Grenada, without including the *presidencia of Quito*. Total population; 1,327,200.

| | | |
|--|-------------------------|------------|
| Ancient <i>Presidencia</i> of Quito. | Quito | 230,000 |
| | Quixos and Macas..... | 35,000 |
| | Cuenca | 78,000 |
| | Jaen de Bracamoros | 13,000 |
| | Mainas | 56,000 (!) |
| | Loxa | 48,000 |
| | Guayaquil | 90,000 |
| <hr/> | | 550,000 |

There results from these data of the official Gazette of Columbia, for the three great divisions of the ancient vice-royalty of Santa Fé,

| | |
|-------------------|-----------|
| VENEZUELA..... | 766,000 |
| NEW GRENADA | 1,327,000 |
| QUITO | 550,000 |
| <hr/> | |
| | 2,643,000 |

This total estimate nearly accords with that which I had published twelve years before in my *Political Essay on New Spain* (vol. ii, p. 851). It is not founded on an actual numeration, but “on the reports made by the deputies of each province to the congress of Columbia, to settle the law of elections.” (*El Argos de Buenos Ayres*, N^o 9, Novem-

ber 1822, p. 3, and *Colombia, being a statistical account of that Country*, 1822, vol. i, p. 375). The congress not having been able to consult the deputies of Quito, the population of that *presidencia* has probably been estimated too low. It is given in the official Gazette nearly the same as it was found in 1778, while the estimate of the *audiencia* of Santa Fé gives an increase in 43 years of more than $\frac{70}{100}$. It is to be hoped, that an enumeration made with precision will soon dissipate the doubts we entertain on the statistics of Colombia. It appears to me probable, that, notwithstanding the devastations of war, the population will be found above 2,900,000.

PERU. The estimate of the population indicated in the table is not too high. The works printed at Lima (*Guia politica del Vireynato del Perú parà el año 1793, publicada por la Sociedad academica de los Amantes del pays*) estimated the population, thirty years ago, at a million of inhabitants, of which 600,000 were Indians, 240,000 mestizoes, and 40,000 slaves. The inhabited part of the country has a surface of only 26,220 square leagues; and a large and fertile part of Upper Peru has belonged ever since 1778 to the viceroyalty of Buenos Ayres.

CHILI. An enumeration, made in 1813, gave 980,000 souls. Mr. d'Yrisarri, who fills an important office in the government of Chili, thinks, that the population may already have attained 1,200,000.

BUENOS AYRES. According to the official documents communicated to Mr. Rodney, one of the commissioners sent by the president of the United States to Rio de la Plata in 1817, the population was two millions. At that period it was found to be 965,000, exclusive of the Indians. The number of natives is extremely considerable in Upper Peru, that is, in the *Provincias de la Sierra*, which belong to the

state of Buenos Ayres. The official returns estimated the Indians alone, in the province of Buenos Ayres, at 130,000 ; in that of Cordova, at 25,000 ; in the intendance of Cochabamba, at 371,000 ; in that of Potosi, at 230,000 ; and in that of Charcas, at 154,000. The inhabitants of every description (Indians, mestizoes, and whites), in the province of Paz alone, were computed at 400,000.

From these statements it results, that in some districts the returns had included the whole population ; and in others the number of whites, mulattoes, and mestizoes only, excluding the natives of copper-coloured race. Now, confining ourselves to the eight provinces of the first description only (namely, Buenos Ayres, Cordova, Cochabamba, Potosi, Charcas, Santa Cruz, la Paz, and Paraguay), we obtain 1,805,000 souls. The provinces and districts of Tucuman, Santiago del Estero, the Valley de Catamarca, Rioja, San Juan, Mendoza, San Luis, Jujuy, and Salta, are wanting in this amount. As they contain, according to other returns, near 330,000 souls, exclusive of the Indians, we cannot doubt, that the total population of the ancient viceroyalty of Buenos Ayres, or la Plata, already comprises two millions and a half of inhabitants of all descriptions. (*Message from the President of the United States at the commencement of the session of the fifteenth Congress, Washington, 1818, p. 20, 41, and 44*). The very particular estimates * obtained by Mr. Brackenridge, secretary to the mission of the United States at Buenos Ayres, and published in a work replete with philosophic views, give to Upper Peru alone, that is, to the four intendencies of Charcas, Potosi, La Paz, and Cochabamba, a population of 1,716,000.

UNITED STATES. According to the increase hitherto observed, the population of the United States will amount, at

* See note D. at the end of the 9th Book.

the commencement of the year 1823, to 10,220,000, of these 1,623,000 being slaves. It was found in

| | |
|------|--|
| 1700 | 262,000 (uncertain). |
| 1753 | 1,046,000 (<i>idem</i> , Mr. Pitkin). |
| 1774 | 2,141,307 (<i>idem</i> , Gov. Pownall). |
| 1790 | 3,929,328 (first certain numbering). |
| 1800 | 5,306,032. |
| 1810 | 7,239,903. |
| 1820 | 9,637,999. |

This last enumeration gives 7,862,282 whites ; 1,537,568 slaves ; and 238,149 free men of colour. According to a very interesting work published by Mr. Harvey (*Edinb. Philos. Journal* ; *January*, 1823, p. 41), the decennial augmentation of the population of the United States was, from 1790 to 1820, successively, 35, 36·1, and 32·9, per cent. The retardation felt in the increase therefore is yet only 2 or 3 per cent for ten years, or one eleventh of the total increase*.

BRAZIL. It has hitherto been fixed at three millions† ; but the estimate which I give in the table is founded on official unpublished pieces, which I owe to the kindness of Mr. Adrien Balbi, of Venice, who was enabled by a long stay at Lisbon, to throw great light on the statistics of Portugal and the Portuguese colonies. According to the report made to the king of Portugal in 1819, on the population of his possessions beyond sea, and according to different statements furnished by the captains general, governors of provinces (conformably to the decrees of Rio Janeiro of the 22d of August and the 30th of September, 1816), Brazil, about the year 1818, had a population of 3,617,900 inhabitants ; namely,

* See note E. at the end of the 9th Book.

† *Brakenridge*, *Voyage to South America*, Vol. i, p. 141.

1,728,000 Negro slaves (*pretos captivos*).

843,000 whites (*brancos*).

426,000 freemen, of mixed blood (*mestissos, mulatos, mamalucos libertos*).

259,400 Indians of different tribes (*Indios de todas as castas*).

202,000 slaves of mixed blood (*mulatos captivos*).

159,000 free blacks (*pretos foros de todas as nações africanas*).

3,617,900.

The whole of these returns not having been made at the same period, this state of the population may be considered as relative to the years 1816 and 1818. The population of Brazil, however, must have augmented considerably during the last four or five years. According to documents presented to the house of commons at London in 1821, we see, that the port of Bahia received from January the 1st 1817, to January the 7th 1818, 6070 slaves, and that of Rio Janeiro, 18,032. In the course of the year 1818, the latter port received 19,802 Negroes. (*Report made by a committee to the directors of the African Institution, on the 8th of May, 1821, p. 37.*) I have no doubt, that the population of Brazil is at present more than four millions. It was consequently estimated very high in 1798 (*Essai polit. sur le Mexique, vol. ii, p. 855.*) Mr. Correa de Serra believes, from the ancient returns which he was enabled to examine with care, that the population of Brazil in 1776, was 1,900,000 souls; and the authority of this statesman is of great weight. A table of the population, brought home by Mr. de Saint-Hilaire, correspondent of the Institute, estimates the population of Brazil, in 1820, at 4,396,132; but in this table, as the learned traveller well observes, the number of wild and *catechised* Indians (800,000) and of free men (2,488,743) is singularly exaggerated; while the number of slaves (1,107,389) is much too small. (See *Velloso de Oliveira, Statistique da Brazil, in the Annaes Fluminenses de sciencias, 1822, tom. i, §. 4.*)

Having continued during some years to make laborious researches concerning the population of the new states of Spanish America, of the West Indian Islands, and of the wandering Indian tribes in both Americas, I think I may attempt afresh to trace a sketch of the total population of the New World for the year 1823.

| | | |
|--|------------|------------|
| I. CONTINENTAL AMERICA, NORTH OF THE ISTHMUS OF PANAMA | | 19,650,000 |
| English Canada | 550,000 | |
| United States..... | 10,220,000 | |
| Mexico and Guatemala | 8,400,000 | |
| Veragua and Panama | 80,000 | |
| Independent Indians, perhaps... | 400,000 | |
| II. INSULAR AMERICA..... | | 2,473,000 |
| Hayti (Saint Domingo) | 636,000 | |
| English West India islands ... | 734,500 | |
| Spanish(exclusive of Margareta) | 800,000 | |
| French | 220,000 | |
| Dutch, Danish, &c. | 82,500 | |
| III. CONTINENTAL AMERICA, SOUTH OF THE ISTHMUS OF PANAMA | | 12,161,000 |
| Columbia (exclusive of Veragua and Panama) | 2,705,000 | |
| Peru | 1,400,000 | |
| Chili | 1,100,000 | |
| Buenos Ayres..... | 2,300,000 | |
| English, Dutch, and French Guyana | 236,000 | |
| Brazil..... | 4,000,000 | |
| Independent Indians, perhaps | 420,000 | |
| Total..... | | 34,284,000 |

The total population of the Archipelago of the West Indies is probably not less than two millions and a half, although the particular distribution of this population amid the different groupes of islands may admit some changes on farther inquiry. These verifications are especially requisite for the free inhabitants of the English islands, the Spanish part of the republic of Hayti, and Portorico.

B. AREA.

It is almost superfluous to relate the precautions, that Mr. Mathieu and myself employed in the calculation of surfaces, either by decomposing the irregular figures of the new states into appropriate trapeziums and triangles, measuring the sinuosities of the exterior limits by means of small squares traced on transparent paper, or rectifying maps on a large scale. Notwithstanding these precautions, operations of this kind may yield very different results; first, because the maps used for this purpose may have been constructed on astronomical data that are not equally precise; secondly, according as the frontiers are traced conformably to the various pretensions of bordering states; thirdly, according as, admitting the legality of the limits, and that they have been astronomically determined with sufficient precision, we exclude from the estimation of the *area* the countries that are *entirely uninhabited*, or occupied by savage nations. It may be conceived, that the first cause chiefly affects the superficial measurement, where the frontiers stretch, as for instance in Peru, along the Cordilleras from north to south. Errors in longitude are known to be in general more frequent and greater than those in latitude; the latter, however, would lead to vary the *area* of the republic of Columbia more than 4600 square leagues, if we were to suppose * as heretofore, on the southern frontier of

* See above, vol. v, p. 414., and note F at the end of the 9th Book.

Spanish Guyana and Brazil, the fort of San Carlos del Rio Negro to be situate under the equator ; a fort which I found, by the observations made at the rock of Culimacari, to be in $1^{\circ} 53' 42''$ of north latitude. The second cause of uncertainty, that which relates to political disputes respecting the limits, is of high importance, wherever the Portuguese territory is contiguous to that of the Spanish Americans. The manuscript maps traced at Rio Janeiro or Lisbon have little resemblance with those that are constructed at Buenos Ayres and Madrid. I have spoken in the 23d Chapter * of the interminable operations attempted by the *commissions of limits*, which have been established during forty years in Paraguay, on the banks of the Caqueta, and in the *Capitania general* of the Rio Negro. The most important points of discussion, according to the study I have made of this great diplomatic controversy, are between the sea † and the river

* Vol. v, p. 297.

† Since the usurpation of the territory of Montevideo by the Portuguese, the limits between the state of Buenos Ayres and Brazil have undergone great changes in the *eastern banda*, or *Cisplatine* province, that is on the northern bank of the Rio de la Plata, between the mouth of this river, and the left bank of the Uruguay. The coast of Brazil from 30° to 34° of south latitude resembles that of Mexico between Tamiagua, Tampico, and the Rio del Norte. It is formed by narrow peninsulas, behind which great lakes and marshes of salt water are situate (Laguna de los Pathos, Laguna Merim). The two Portuguese and Spanish *marcos* lie toward the southern extremity of the Laguna Merim, into which runs the small river of Tahym (lat. $32^{\circ} 10'$). The plain between Tahym and Chuy was regarded as neutral territory. The little fort of Santa Theresa (lat. $33^{\circ} 58' 32''$, according to the manuscript map of don Josef Varela) was the most northern post possessed by the Spaniards on the coast of the Atlantic Ocean, south of the equator.

Uruguay, the banks of the Guaray and the Ibicuy, and those of the Iguaçu and the Rio S. Antonio; between the Parana and the Rio Paraguay, the banks of the Chichuy, south-east of the Portuguese fortress of Nova Coimbra*; on the eastern frontiers the Spanish provinces of Chiquitos and Los Moxos, the Banks of the Aguapehy, the Yauru, and the Guapore, a little to the east of the isthmus that separates the tributary streams of the Paraguay and the Rio de la Madeira, near the Villa Bella (lat. $15^{\circ} 0'$); on the south and north of the Amazon, the land completely unknown between the Rio de la Madeira and the Rio Javary (south lat. $10\frac{1}{2}^{\circ}$ — 11°); the plains between the Putumayo and the Japura between the Apoporis, which is a tributary stream of the Japura, and the Uaupes, that falls into the Rio Negro†; the forests on the south-west of the mission of Esmeralda, between the Mavaca, Pacimoni, and Cababuri‡; and finally, the northern part of the Rio Branco and of the Uraricuera,

* Nova Coimbra (lat. $19^{\circ} 55'$) is a *presidio* founded in 1775, and is probably the most southern Portuguese settlement on the Rio Paraguay. In different Spanish and Portuguese maps, the Yaguary (Menici, Monici), a large tributary stream of the Parana, is usually fixed on as the frontier between Parana and Paraguay toward the east; toward the west sometimes the Chichuy (Xexuy) and Ipane, near the ancient mission of Belen (lat. $23^{\circ} 32'$), sometimes the Mboimboy (lat. $20^{\circ} 27'$), opposite the destroyed mission of Itatiny, and sometimes (lat. $19^{\circ} 35'$), the Rio Mondego or Mbotetey, near the destroyed town of Xerez; all three tributary streams of the Paraguay on it's eastern side. The boundary nearest Nova Coimbra, that of Rio Mboymboy, has been pretty generally adopted provisionally between Brazil and the ancient viceroyalty of Buenos Ayres.

† See above, vol. v, p. 334.

‡ Vol. v, p. 475, and p. 558.

between the little Portuguese fort of San Joaquim and the sources of the Rio Carony * (lat. $3^{\circ} 0' - 3^{\circ} 45'$). Some stones (*piedras de marco*) have been placed to mark the limit between Spanish and Portuguese America; and are decorated † with the following pompous inscription: *Pax et Justitia osculatae sunt. Ex pactis finium regundorum Madridi Idibus Jan. 1750*; but the connexion of these points, very distant from one another, the definitive fixation of the limits, and their solemn recognition, have never been obtained. All that has hitherto been done is regarded only as provisional, and in the meantime the two neighbouring nations, without relinquishing the extension of their rights, maintain a state of peaceable possession. We have mentioned above, that, if a canal of 5,300 toises long ‡ were substituted for the portage of Villa Bella ($15 \frac{1}{2}^{\circ}$), between the Rio de la Madeira and the Rio Paraguay, an *inland navigation* would be opened between the mouth of the Oronoko and that of the Rio de la Plata, between Angostura and Montevideo. The course of the great rivers in the direction of the meridians would perhaps afford a *natural boundary* between the

* Vol. v, p. 481, and p. 789.

† As at the point where the Rio Jauru enters the Paraguay. See the *Patriota de Rio Janeiro*, 1813, N^o 2, p. 54.

‡ The portage (*varadoiro*), properly speaking, is between the little rivers Aguapehy and Alegre. The former runs into the Jauru, which is a tributary stream of the Paraguay; the Rio Alegre falls into the Guapore, a tributary stream of the Rio de la Madeira. The sources of the Rio Topayos lie also very near the Villa Bella and the sources of the Paraguay. This country, which forms a *land isthmus* between the basins of the Amazon and the Rio de la Plata, will be one day of the highest importance for the inland trade of South America.

Portuguese and Spanish possessions ; a boundry that would accompany the Oroonoko, the Cassiquiare, the Rio Negro, the banks of the Amazon, for a distance of twenty leagues, the Rio de la Madeira, the Guapore, the Aguapehi, the Jauru, the Paraguay, and the Parana, or Rio de la Plata, and would form a line of demarcation of more than eight hundred and sixty leagues. On the east of this boundary the Spanish Americans possess Paraguay, and a part of Spanish Guyana ; and on the west, the Portuguese Americans have occupied the country between the Javary and the Rio de la Madeira, and between the Putumayo and the sources of the Rio Negro. It is not from the coasts of Brazil and Peru only, that civilization has advanced toward the central regions ; it has penetrated them also by three other roads, the Amazon, the Oroonoko, and the Rio de la Plata ; and has ascended the tributary streams of those three rivers and their secondary branches. From the increase of these routes, and their various directions, a configuration of territory and a sinuosity of frontier have resulted, no less difficult to determine astronomically, than disadvantageous to inland trade.

To the two causes of uncertainty in the estimation of surfaces, which we have just analyzed, namely, the errors of astronomical geography, and the discussions of limits, may be added a third, the most important of all. When we speak of the *area* of Peru, or of the ancient *Capitania-general* of Caraccas, it may be doubted whether these names denote only the country in which the Spanish Americans have made settlements, and which consequently depend on their political and religious hierarchy ; or whether we should join to the country governed by the whites (by *corregidores*, chiefs of military posts, and missionaries), the forests and savannahs partly desert, and partly inhabited by savages, that is by native and free tribes. We have seen above, that in the interior errors easy to suppose of 1° of latitude, or 2° of

longitude*, may, on frontiers of 300 leagues, enlarge or diminish the surfaces of new states to the extent of 12,000 square leagues; but much more important differences arise from lines of demarcation drawn somewhat arbitrarily between the lands that are regularly inhabited, and those that are desert, or the dwellings of savage tribes. The *limits of civilization* are more difficult to trace than *political limits*. Little missions governed by monks are dispersed along a river; they may be termed the outposts of European civilization, and, ranged in narrow and winding lands, advance

* I estimate the errors of *relative longitudes* only, for instance, the differences of longitude between the coast, and the valley of the Rio Mamore, or of the Upper Javari. I do not speak of the errors of *absolute longitude*, which sometimes exceed 3° or 4°, without influencing the measure of surfaces. The longitude of the city of Quito ascertained by me (81° 5' 30" west of Paris) has caused a considerable change of the western part of America, in the most recent maps. This differs 0° 50' 30", from the longitude adopted till my return to Europe (*Connoiss. des Temps pour l'année* 1808, p. 236). The breadth of South America, between Cayenne and Quito, according to d'Anville, is 30 nautical leagues too little. It is the *inequality of partial displacements*, that occasions the errors of *relative longitude* which alter the calculation of the *area*. La Cruz Olmedilla, whose great map has been successively copied and disfigured, placed Santa Fe de Bogota half a degree too far to the east; San Carlos del Rio Negro 2½°; and the mouth of the Apure a quarter of a degree. The distance of Cumana from the mission of Esmeralda on the Upper Oroonoko, is estimated by La Cruz 2¼° too little. In general, before my voyage, the whole system of the rivers Oroonoko and Rio Negro was placed from 1° to 1½° of latitude too far south, and 2° of longitude too far east.

more than a hundred leagues amid forests and deserts. Ought the territory to be considered as Peruvian or Columbian, lying between these solitary villages, these crosses erected by the monks of Saint Francis, and surrounded by a few Indian huts? The hordes that wander on the border of the missions of the Upper Oroonoko, the Carony, the Temi, the Japura, the Mamore, a tributary stream of the Rio de la Madeira, and the Apurimac, a tributary stream of the Ucayale, scarcely know the existence of white men. They are ignorant that the countries, which they have possessed for years, are included, according to the political doctrines of *closed territory* (*territoire fermé*), within the limits of the states of Venezuela, New Grenada, and Peru.

In the present state of things, there is a *contiguity of cultivated lands*, or rather a *contiguity of Christian settlements* only, on a very small number of points. Brazil touches Venezuela only by the band of the missions of the Rio Negro, Cassiquiare, and Oroonoko; and Peru only by the missions of the Upper Oroonoko, and those of the province of Maynas, between Loreto and Tabatinga. The different states in the New World are connected only by narrow slips of cleared lands. Between the Rio Branco and the Rio Carony, the Javary and the Guallaga, the Mamoré and the mountains of Cusco, lands inhabited by savages, and which have never been traversed by whites, separate, like arms of inland seas, the civilized parts of Venezuela, Brazil, and Peru. (Compare above, Chap. xii, Vol. iii, p. 431—427.) European civilization is spread as in divergent rays from the coast, or the high mountains near the coast, toward the centre of South America; and the influence of governments diminish in proportion to the distance from the shore. Missions entirely dependent on monastic power, inhabited only by the race of copper-coloured natives, form a vast zone around regions more anciently cleared; and these Christian settlements are placed on the borders of savannahs and

forests, between the agricultural and pastoral life of the colonists, and the wandering life of hunting tribes. In maps constructed at Lima, the territory of the most eastern Peruvian intendances (Tarma and Couzco) frequently is not extended so far as the frontiers of Grand Para and Matto Grosso; those parts only that are subject to the whites (*terras conquistadas*) being called Peru, and the rest are marked by the vague denominations of unknown land, Indian countries, savage countries (*paises desconocidos, comarca desierta, tierras de Indios bravos y infieles*). The whole of Peru, extending it as far as the Portuguese limits, is 41,420 square nautical leagues, while, if we abstract the wild and unknown countries between the frontiers of Brazil and the eastern banks of the Beni and the Ucayale, we find only 26,220 square leagues. We shall soon see, that, in the ancient viceroyalty of Buenos Ayres, now called the *United States of the Rio de la Plata*, the difference is still greater. In the same manner we may compute Brazil at 257,000 or 118,000 square leagues, according as we calculate the whole surface of the country from the coast to the banks of the Mamoré and Javary, or stop at the course of the rivers Parana and Araguay, excluding from the area of Brazil the greater part of the provinces of Matto Grosso, Rio Negro, and Portuguese Guyana, three unpeopled provinces, comprising more than a third of the extent of Europe.

From these considerations we must not be surprised, if geographers, who calculated the surfaces with an equal precision, and according to pretty good maps, found, that the results differed a quarter, a third, and sometimes even more than half. It is not easy to fix the limits of desert regions, or those inhabited by independent natives; the missions advance amid these savage countries, following the beds of the rivers. The calculated surfaces vary according as we estimate the territory only which the missionaries have acquired, or add the forests interposed between their acquisitions. Thus the want of conformity observable between

the preceding table, and that calculated by Mr. Oltmanns in 1806, results only from *the exclusion of the countries not submitted to the governance of the whites*. The ancient estimates are all necessarily less than the new, which present the total area. In reducing common leagues to nautical leagues, I reckoned in the *Essai politique sur la Nouvelle-Espagne* (Tom. ii, p. 851) 299,810 square leagues (twenty to a degree) for the whole of Spanish America; 30,628 for Venezuela, or the ancient *capitania general* of Caraccas; 41,291 square leagues for New Grenada; 19,449 for inhabited Peru (according to the frontiers indicated in the *Map of Intendancies*, published at Lima in 1792, by Don Andrew Baleato); 14,447 square leagues for Chili; and 91,528, for the United Provinces of Rio de la Plata, or the ancient viceroyalty of Buenos Ayres. What I have just stated on the calculations of the surfaces of Spanish America, and the causes from which these calculations vary, may be equally applied to the territory of the United States, which on the west has been terminated at different periods by the Mississippi, the stony Mountains, and the coast of the Pacific Ocean. The *territory of Missouri*, and that of *Arkansas*, have been long in some sort without frontiers toward the west; they resemble in this point of view the province of the Chiquitos of South America. In the following tables I have adopted a different method of calculation from that which I had hitherto observed; I have estimated the extent of land, which the increasing population of each state will fill in the lapse of ages. The lines of division (*lineas divisorias*) adopted are such as they are found according to received traditions, and the rights acquired by long and peaceable possession, on the manuscript Spanish and Portuguese maps in my collection. Where the maps of the two nations differed considerably, these differences have been attended to, and the medium taken as the results. The numbers on which I have fixed in the preceding table consequently indicate the *maximum* of surface furnished to the

industry of the states of Columbia*, Peru, and Brazil; but as the political strength of states at a given period depends less on the proportion of their total extent to the number of their inhabitants, than on the degree of concentration of the greater part of the population, I have estimated the inhabited and uninhabited parts separately. I have less hesitated in adopting this method, because some respectable persons in the new governments established in Spanish America have wished, for the benefit of their internal administration, to know at the same time the total and the partial surfaces. The denomination of provinces will probably undergo frequent changes, as is the case in all societies recently formed. Different combinations are tried, before a state of equilibrium and stability is attained; and if innovations of this kind have been less frequent in the United States, we must not attribute this to the national character alone, but to that happy situation of the Angloamerican colonies, which, governed from their origin by excellent political institutions, possessed liberty previous to independence.

* In the declaration of the congress of Venezuela, of the date of December 17th, 1819, a declaration which is regarded as the *fundamental law* of the republic of Columbia, the territory is estimated (article 2) at 115,000 square leagues, without adding the value of these leagues. If they be nautical leagues, which is very probable, the estimate is 25,000 leagues too great (once and a half the *area* of France). Maps must have been consulted, which were not corrected according to the astronomical observations made at the southern and eastern frontiers. All the estimates of *area* hitherto published in the new states of America are very inexact. I except the partial statements of the *Abeja argentina* (1822, N° i, p. 8), an interesting journal published at Buenos Ayres.

NEW SPAIN. The surface of this vast country has been calculated with great care by Mr. Oltmanns, according to the limits marked on my large map of Mexico. There will soon probably be some changes on the north of San Francisco and beyond the Rio del Norte, between the mouth of the Rio Sabina and that of the Rio Colorado de Texas. The assertions made on my map of Mexico, drawn in 1804, and published in 1809, relative to the identity of the Rio Napestle and the Rio de Pecos, with the rivers which bear the names of Arkansas, and the Red River of the Natchitoches in Louisiana, have been fully justified by the journey of major Pike, which appeared at Philadelphia in 1810.

GUATIMALA. This country, so little known, contains the provinces of Chiapa, Guatemala, Vera Paz or Tezulutlan, Honduras (towns: Comayagua, Omoa, and Truxillo), Nicaragua, and Costa Rica *. The coast of Guatemala extends on the south sea from Barra de Tonalà (lat. $16^{\circ} 7'$, long. $96^{\circ} 39'$), on the east of Tehuantepec, to la Punta de Burica or Boruca (lat. $8^{\circ} 5'$, long. $85^{\circ} 13'$), on the east of the Golfo Dulce de Costa Rica. From this point, the frontier ascends successively to the north, stretching along the Columbian province of Veragua, toward Cape Careta, (lat. $9^{\circ} 35'$, long. $84^{\circ} 43'$), which advances into the Caribbean sea a little to the west of the fine port of Bocca del Torro; to the N.N.W. along the coast, as far as the river Bluefields, or Nueva Segovia (lat. $11^{\circ} 54'$, long. $85^{\circ} 25'$), in the territory of the Moschetto Indians; toward the N.W., along the river Nueva Segovia for forty leagues; and finally, to the N. at Cape Camaron (lat. $16^{\circ} 3'$, long. $87^{\circ} 31'$) between Cape Gracias a Dios and the port of Truxillo. From Cape

* Juarros, *Compendio de la Hist. de Guatemala*, printed at Guatemala, 1809, vol. i, p. 5, 9, 31, 56; vol. ii, p. 39. Jose Cecilio Valle, *Periodico de la Sociedad economica de Guatemala*, vol. i, p. 38.

Camaron the coast of Honduras, stretching W. and N., forms the frontier as far as the mouth of the river Sibun (lat. $17^{\circ} 12'$, long. $90^{\circ} 40'$). Thence, this frontier follows the course of the Sibun to the E., crosses the Rio Sumasinta, which runs into the Laguna de Terminos, stretches toward the Rio de Tabasco or Grixalva, as far as the mountains that command the Indian town of Chiapa, and turns to the S.W., to rejoin the coasts of the South Sea at la Barra de Tonala.

CUBA and PORTORICO. The *area* for Portorico is calculated from the maps of the Hydrographic Depot at Madrid; for the island of Cuba, from the map, which I constructed in 1820, from my own astronomical observations, and from the whole of the data hitherto published by Messrs. Ferrer, Robredo, Lemaux, Galiano, and Bauza.

COLUMBIA. The following are the actual limits of the republic of Columbia, according to the information which I obtained on the spot, particularly at the southern and western extremities; that is at Rio Negro, Quito, and in the province of Jaen de Bracamoros. Northern coast, that of the Caribbean sea, from Punta Careta (lat. $9^{\circ} 36'$, long. $84^{\circ} 43'$), on the eastern frontier of the province of Costa Rica (belonging to the state of Guatemala), to the rivers Moroco and Pamaroun*, east of Cape Nassau. From this

* See above, vol. v, p. 753—5. Great uncertainty still prevails respecting the situation of this point, the most eastern of the territory of Columbia. A farther reason for the longitudes being ill determined between the mouth of the Oroonoko and English Guyana is, that they have not been connected together by chronometric means. The mouth of the Rio Pomaroun or Poumaron depends on the position both of the Punta Barima and of the Rio Essequibo (Esquibo). Now, Cape Barima is half a degree too far to the

point of the coast (lat. $7^{\circ} 35'$, long. $61^{\circ} 5'$), the frontier of Columbia stretches across the savannahs, in which some little granitic rocks stand prominent, first S. W., and then S. E., toward the confluence of the Rio Cuyuni with the

east on the great map of South America published by Mr. Arrowsmith. This geographer indicates with sufficient precision Puerto Espana, in the island of Trinidad ($65^{\circ} 50'$); but he makes the difference of longitude between Puerto Espana and Punta Barima to be $1^{\circ} 52'$, while it is only $1^{\circ} 31'$, as determined with great precision by the operations of Churruca (See above, vol. v, p. 718, and *Espinosa Memorias de los Navegantes Espanoles*, Vol. i, N^o 4, p. 80—82). The south-east bank of the mouth of the Oroonoko is in $8^{\circ} 40' 35''$ latitude, and $62^{\circ} 23'$ longitude. If we determine the mouth of the Rio Essequibo by the difference of longitude from Cape Barima generally adopted ($1^{\circ} 22'—1^{\circ} 30'$), we shall find the Essequibo to be about $60^{\circ} 53'$. This is nearly the position fixed on by Mr. Buache, in his map of Guyana (1797), which indicates the longitude of Cape Barima ($62^{\circ} 23'$) very well also. Several geographers, captain Tuckey for instance (*Maritime Geography*, Vol. v, p. 733), believes the middle of the mouth of the Essequibo to be in $60^{\circ} 32'—60^{\circ} 41'$; and it is probable, that the mouth of this river has been compared with the position of Surinam, or that of Stabrock, the flourishing capital of Demerary. The reckoning on this coast, however, where the current sets strongly to the N. W., tends to diminish the differences of longitude in sailing from Cayenne to Cape Barima, and to the island of Trinidad. The longitude of the mouth of the little river of Moroco, situate near that of Pomaroun, and serving as the frontier between the English colony of Guyana and the territory of Columbia, depends on the longitude of the Rio Essequibo, from which it is $45'$ distant, according to Bolingbroke, toward the west, and from $30'$ to

Masuruni, where formerly a Dutch post was established * opposite the Cano Tupuro. Crossing the Masuruni, the boundary runs along the western banks of the Essequibo and Rupunuri, as far as the point where the Cordillera of Pacaraimo (4° of north latitude) gives a passage to the Rio Rupunuri, which is a tributary stream of the Essequibo; then, following the southern declivity of the cordillera of Pacaraimo, which separates the waters of Caroni from those of the Rio Branco, it goes successively toward the west, by Santa Rosa (nearly lat. $3^{\circ} 45'$, long. $65^{\circ} 20'$), to the sources of the Oroonoko, lat. $3^{\circ} 40'$, long. $66^{\circ} 10'$); toward the S. W., to the sources of the Rio Mavaca and the Idapa (lat. 2° , long. 68°), and, crossing the Rio Negro at the island of San Jose (lat. $1^{\circ} 38'$, long. $69^{\circ} 58'$) near S. Carlos del Rio Negro; toward W. S. W., through plains entirely unknown, to the *Gran Salto del Yapura*, or Caqueta, situate near the mouth of the Rio de los Engaños (south lat. $0^{\circ} 35'$); and finally makes an extraordinary turn toward the S. E. at the confluence of the Rio Yaguas with the Putumayo, or Iça (south lat. $3^{\circ} 5'$); the point where the Spanish and

$35'$, according to other maps recently published. A manuscript map of the mouths of the Oroonoko in my possession gives but $25'$. It results from these minute discussions, that the longitude of the mouth of the Pomaroun is between $60^{\circ} 55'$ and $61^{\circ} 20'$. I here reiterate the wish I have already expressed in another place, that the government of Columbia may connect chronometrically, and by an uninterrupted navigation, the mouth of the Essequibo, Cape Nassau, Punta Barima (Old Guyana and Angostura), the *bocas chicas* of the Oroonoko, Puerta Espana, and Punta Galera, which is the north-east cape of the island of Trinidad.

* We must not confound this post with the ancient Spanish post *destacamento de Cuyuni*), on the right branch of the Cuyuni, at the confluence of the Curumu.

Portuguese missions of the lower Putumayo come into contact. From this point the frontier of Columbia goes toward the south, crossing the Amazon near the mouth of the Javary, between Loreto and Tabatinga, and stretching along the eastern bank of the Rio Javari, as far as 2° distant from it's confluence with the Amazon; to the W., crossing the Ucayale and the Rio Guallaga, the latter between the villages of Yurimaguas and Lamas (in the province of Maynas, $1^{\circ} 25'$ south of the confluence of the Guallaga with the Amazon); to the W. N. W., crossing the Rio Utcubamba, near Bagua Chica, opposite Tomependa. From Bagua the frontier stretches S. S. W., toward a point of the Amazon (lat. $6^{\circ} 3'$) situate between the villages of Choros and Cumba, between Collac and Cuxillo, a little below the mouth of the Rio Yaucan; it then turns westward, crossing the Rio de Chota, toward the Cordillera of the Andes, near Querocotillo, and to the N. N. W., stretching along and passing over the cordillera between Landaguata and Pucara, Guancabamba and Tabaconas, Ayavaca and Gonzanama (lat. $4^{\circ} 13'$, long. $81^{\circ} 53'$), to reach the mouth of the Rio Tumbes (lat. $3^{\circ} 23'$, long. $82^{\circ} 47'$). The coast of the Pacific Ocean bounds the territory of Columbia for 11° of latitude, as far as the western extremity of the province of Veragua, or Cape Burica (N. lat. $8^{\circ} 5'$, long. $83^{\circ} 18'$; from this cape the frontier runs toward the north (across the enlarged isthmus which forms the continent between Costa Rica and Veragua), and rejoins the Punta Careta on the coast of the Caribbean Sea, west of the lake of Chiriqui, whence we departed to make the tour of this immense territory of the republic of Columbia.

These indications may serve to rectify the maps, even the most modern of which, published under the auspices of Mr. Zea, and said to be constructed from the materials I had collected *, traces vaguely the state of a long and

* Columbia, from Humboldt and other recent authorities, London, 1823.

peaceful possession between bordering nations. It is customary to consider the whole southern bank of the Japura as Spanish, from the Salto Grande as far as the inland delta of the Abatiparana, where, on the northern bank of the Amazon, a *marco de limites* is placed, a stone which the Portuguese astronomers found in lat. $2^{\circ} 20'$, and long. $69^{\circ} 32'$. (*Manuscript Map of the Amazon, by Don Francisco Requena, commissary of limits to his Catholic Majesty, 1783.*) The Spanish missions of Japura or Caqueta, commonly called *missions des Andaquies*, extend no farther than Rio Caguan, a tributary stream of the Japura, below the destroyed mission of S. Francisco Solano. All the west of the Japura, south of the equator, from the Rio de los Enganos and the Great Cataract, is in the possession of the natives and the Portuguese. The latter have some small settlements at Tabocas, S. Juquin de Cuerana, and Curatus; the second of which is on the south of the Japura, the third on it's northern tributary stream, the Apoporis*. According to the Portuguese astronomers, it was at the mouth of the Apoporis, in lat. $1^{\circ} 14'$ south, long. $17^{\circ} 58'$, (west of the meridian of Paris), that the Spanish commissioners were willing to place the stone of the limits in 1780, which denoted an intention of not preserving the *marco* of Abatiparana. The Portuguese commissaries opposed taking the Apoporis for the frontier, asserting, that, in order to cover the Brazilian possessions on the Rio Negro, the new *marco* ought to be placed at the *Salto Grande del Japura* (south lat. $0^{\circ} 33'$, long. $75^{\circ} 0'$). In Putumayo or Iça, the most southern Spanish missions (*missiones baxas*), governed by the ecclesiastics of Popayan and Pasto, do not extend as far as the confluence of the Amazon, but only to $2^{\circ} 20'$ of south latitude, where the small villages of Marive, S. Ramon, and Asumpcion, are situate. The Portuguese are masters

* See above, Vol. v, p. 336—339.

of the mouth of the Putumayo ; and, to reach the missions of Baxo Putumayo, the monks of Pasto are obliged to go down the Amazon to Pevas, below the mouth of the Napo ; to proceed from Pevas to the north by land, as far as *Quebrada*, or *Caño* de Yaguas, and enter the Rio Putumayo by this *Caño*. Neither can the left bank of the Amazon, from Abatiparana (long. $69^{\circ} 32'$) to Pongo de Manseriche, at the western extremity of the province of Maynas, be considered as the boundary of New Grenada. The Portuguese have always had possession of both banks as far as to the east of Loreto (long. $71^{\circ} 54'$) ; and the situation of Tabatinga, on the north of the Amazon, where the last Portuguese post is placed, sufficiently proves, that the left bank of the Amazon, between the mouth of the Abatiparana and the frontier near Loreto, was never considered by them as belonging to the Spanish territory. To prove likewise, that the southern bank of the Amazon does not form the boundary with Peru from the mouth of the Javari toward the west, I have but to mention the existence of the numerous villages of the province of Maynas, situate on the Guallaga, as far as beyond Yurimaguas, 28 leagues south of the Amazon. The extraordinary sinuosity of the frontier, between the Upper Rio Negro and the Amazon, arises from the circumstance, that the Portuguese introduced themselves into the Rio Yapura by going up toward the N. W., while the Spaniards descended the Putumayo. From the Javari, the Peruvian limit goes beyond the Amazon, because the missionaries of Jaen and Maynas, coming from New Grenada, penetrated into these almost savage regions by the Chinchipe and the Rio Guallaga.

Calculating the surface of the Republic of Columbia, according to the limits we have just traced, we find 91,952 square leagues (20 to a degree) thus :

| POLITICAL DIVISIONS. | Square Leagues. | Square Leagues. |
|---|--------------------|--------------------|
| 1. <i>Venezuela</i> | | 33,701 |
| New Andalusia or Cumana | 1,299 | |
| New Barcelona | 1,564 | |
| Delta of the Oroonoko | 652 | |
| Spanish Guayana | 18,793 | |
| Caraccas | 5,140 | |
| Varinas | 2,678 | |
| Maracaybo | 3,548 | |
| Island of Margarett (ex- cluding the Laguna) | 27 | |
| II. <i>New Grenada</i> (with Quito) ... | | 58,251 |
| REPUBLIC OF COLUMBIA | | 91,952 |

Whatever changes the territorial divisions of Venezuela may yet undergo, whether from the variable wants of the internal administration, or the desire of innovation, always so active at the period of a political regeneration, the exact knowledge of the *area* of the ancient provinces will serve to estimate approximately the *area* of the new. On considering attentively the divisions made for ten years past, we perceive, that, in the different attempts to *reconstruct societies*, the same elements are combined, till a stable equilibrium is found.

Partial Limits :

A.) ANCIENT CAPITANIA GENERAL OF CARACCAS :

a.) GOBIERNO DE CUMANA, comprising the two provinces of New Andalusia and Barcelona, a little less than the state of Pennsylvania, which contains 46,000 square miles (69·2 to a degree). The limit on the south and south-east is formed by the course of the Lower Oroonoko, as far as it's principal

mouth * (*boca de Navios*) ; on the north, by the coasts of the Atlantic Ocean and the Caribbean Sea, from long. $26^{\circ} 23'$ as far as the mouth of the Rio Unare, (long. $62^{\circ} 33'$). From the mouth of this river towards the south, the limit between the provinces of Caraccas and Barcelona first follows the Unare towards it's origin in the hilly country west of the village of Pariaguan, and then stretches to the Oroonoko, between the mouth of the Rio Suata and that of the Rio Caura, $24'$ east of Alta Gracia, called Ciudad Real in the old maps. I fixed in my calculations this point of the longitude of the Oroonoko by deducing it from the longitude of the Rio Caura. It is nearly $68, 3'$ west of the meridian of Paris. Other geographers, Lopez for instance, in his map of the province of Caraccas, makes the limit proceed to the Raudal de Camiseta, eight leagues east of the Rio Caura. In a manuscript map, which I copied in the archives of Cumana, the frontier is marked near Muitaco, at the mouth of the Rio Cabrutica, three leagues east of the Rio Pao. The governors of Cumana long pretended to extend their jurisdiction much beyond the mouth of the Rio Unare, as far as the Rio Tuy, and even as far as Cape Coderat. According to this supposition they draw a line toward the south, 15 leagues east of Calabozo, between the sources of the Rio Uritucu and those of the Rio Manapire, following the latter river as far as it's confluence with the Oroonoko, four leagues to the east of Cabruta †. This, the most western limit, would add an extent of 400 square leagues to the province

* See above, vol. v, p. 717 and 724. I have, however, calculated separately the almost uninhabited delta of the Oroonoko, between the principal branch and the Manamo Grande, the westernmost of the *bocas chicas*. This marshy delta is three times the average extent of a department of France.

† Vol. iii, p. 370.

‡ Vol. v, p. 680.

of Barcelona, containing the *Valle de la Pasqua*, which La Cruz and Caulin mark on their maps by the words, *terreno que disputan las dos provincias de Barcelona y de Caracas*. In my estimation of the *area* I followed the frontier of the Rio Unare, because it determines the *present state of possession* between the neighbouring provinces. The *Gobierno de Cumana* contains four *ciudades* (Cumana, Cariaco, Cumana-coa, Nueva-Barcelona) and four *villas* (Aragua, La Concepcion del Pao, La Merced, and Carupano)*. New cities will probably arise on the shores of the gulf of Paria (*Golfo triste*), as well as on the banks of the Areo and the Guarapiche; since these points offer great advantages to the commercial industry of New Andalusia.

b.) SPANISH GUAYANA; such as it was administered before the revolution of the 5th of July, 1811, by a governor resident at Angostura (Santo Tomè de la Nueva Guayana.) It contains more than 225,000 English square miles, and consequently exceeds the *area* of all the *Atlantic Slave States*, Maryland, Virginia, the two Carolinas, and Georgia. More than nine-tenths of this province are uncultivated, and almost uninhabited. The limits on the east and south, from the principal mouth of the Oroonoko to the island of San Jose de Rio Negro, have been indicated in describing the general configuration of the republic of Columbia. The limits of Spanish Guayana on the north and west are, first the Oroonoko, from Cape Barima to San Fernando de Atabapo, and then a line stretching from north to south, from

* Vol. ii, p. 183—214; Vol. iii, p. 7, 51—67, 159—206, 361; and the present vol. p. 45. I am ignorant of the real position of the Villa de la Merced, indicated in the manuscript map of the archives of Cumana. Piratoo and Manapire appear also to pretend to the title of *villas*. (Caulin; p. 190.)

San Fernando towards a point 15 leagues west of the little fort of San Carlos. The line crosses the Rio Negro a little above Maroa *. The north-east frontier, that of the English Guayana, merits the greatest attention, on account of the political importance of the mouths of the Oroonoko, which I have discussed in the 24th chapter of this work. The sugar and cotton plantations had already reached beyond the Rio Pomaroun under the Dutch government ; they extend farther than the mouth of the little river Moroco, where a military fort is established. (See the very interesting map of the colonies of *Essequibo and Demerara*, published by Major F. de Bouchenroeder, in 1798). The Dutch, far from recognizing the Rio Pomaroun, or the Moroco, as the limit of their territory, placed the boundary at Rio Barima, consequently near the mouth of the Oroonoko itself ; whence they draw a line of demarkation from N. N. W. to S. S. E. towards Cuyuni. They had even taken military occupation of the eastern bank of the small Rio Barima, before the English (in 1666) had destroyed the forts of New Zealand and New Meddelburgh on the right bank of Pomaroun. Those forts, and that of Kyk-over-al, (*look every where around*), at the confluence of the Cuyuni, Masaruni, and Essequibo, have not been re-established. Persons, who had been on the spot, assured me, during my stay at Angostura, that the country west of Pomaroun, of which the possession will one day be contested by England and the republic of Columbia, is marshy, but exceedingly fertile. The towns of Guyana, or rather the places which have the privileges † of *villas* and *ciudades*, are Angostura, Barceloneta, Upata, Guirior (merely a military post at the confluence of the Paraguamusi and the Paragua, a tributary stream of the Caroni), Borbon, Real Corona or Muitaco, La Piedra, Alta Gracia, Caycara, San

* See above, vol. v, p. 195—223, 355, 364, 415.

† Vol. v, p. 679.

Fernando del Atabapo, and Esmeralda (some indian huts around a church).

c.) PROVINCE OF CARACCAS; 61,000 English square miles, consequently about one-seventh less than the state of Virginia. Northern limit: the Caribbean sea from the mouth of the Rio Unare, long. $67^{\circ} 39'$, to the other side of the Rio Maticores (long. $73^{\circ} 10'$) in the direction of the gulf or *Saco* of Maracaybo, on the east of Castillo de San Carlos. Western limit: a line directed towards the south, between the mouth of the Rio Motatan and the town of Carora, by the sources of the Rio Tocuyo and the Paramo de las Rosas*, between Bocono and Guanare; towards the E. S. E., between the Portuguesa and the Rio Guanare or the Caño de Ygues, a tributary stream of the Portuguesa: this line forms the frontier of the provinces of Varinas and Caraccas; and runs on the S. E. between San Jaime and Uritucu, towards a point of the left bank of the Rio Apure, opposite San Fernando. Southern limit: first the Rio Apure, from lat. $7^{\circ} 54'$ long. $70^{\circ} 20'$, to its confluence with the Oronoko, near Capuchino (lat. $7^{\circ} 37'$ long. $69^{\circ} 6'$); then, the Lower-Oronoko towards the east, as far as the western frontier of Gobierno de Cumana, near the Rio Suata, on the east of Alta Gracia. Towns: Caraccas, La Guayra, Portocabello, Coro, Nueva Valencia, Nirgua, San Felipe, Barquesimeto, Tocuyo, Araure, Ospinos, Guanare, San Carlos, San Sebastian, Villa de Cura, Calabozo, and San Juan Baptista del Pao.

d.) PROVINCE OF VARINAS, comprising an area of 32,000 English square miles, rather less than the state of Kentucky. Eastern limit: from the southern extremity of Paramo de las Rosas, and the sources of the Rio Guanare, toward the

* See my Geog. Atlas, pl. 17.

S. E. to the Caño de Ygues ; thence between the Rio Portuguesa and the Rio Guarico, towards the E. S. E., to the mouth of the Apure ; and to the southward along the left bank of the Oroonoko, from the $7^{\circ} 36'$ S. lat. as far as the mouth of the Meta. Southern limit : the northern bank of the Meta, as far as Las Rochellas de Chiricoas, between the mouths of the Caño Lindero and the Macachare (the long, perhaps $70^{\circ} 45'$). Western limit : first, from the left bank of the Meta, to the N. W. across the plains of Cassanare, between Guardualito and the Villa de Arauca, then, to the N. N. W. above Quintero and the mouth of the Rio Nula, which joins the Apure after the Rio Orivante, toward the sources of the Rio Canagua, and the foot of the Paramo de Porquera. Northern limit : the south-east declivity of the Cordillera de Merida, from the Paramo de Porquera, between La Grita and Pedraza, as far as the ravine of Lavellaca, in the road of Los Callejones, between Varinas de Merida and the sources of the Rio Guanare, situate N. N. W. of Bocono. Cities : Varinas, Obispos, Bocono, Guanarito, San Jaime, San Fernando de Apure, Mijagual, Guardualito, and Pedraza. By comparing my map of the province of Varinas with the maps of La Cruz, Lopez, and Arrowsmith, it will be perceived what confusion has hitherto prevailed in the labyrinth of rivers that form the tributary streams of the Apure and the Oroonoko.

e.) *Province of Maracaybo*, (together with Truxillo and Merida) comprising 42,500 English square miles, of rather less extent than the state of New York. Northern limit : the shore of the Caribbean Sea, from the Caño de Oribono (to the westward of the Rio Maticores) as far as the mouth of the Rio Calancala, a little to the eastward of the great river del Hacha. Western limit : a line first stretching from the coast to the southward, between the Villa de Reyes, called also Valle de Upar, and the small group of mountains (Sierra de Perija) that rise on the west of the

lake of Maracaybo, towards the Rio Catatumbo; then to the eastward of Salazar to the Rio Sulia, a little above San Faustino; and finally on the east, to the Paramo of Porquera, situate to the N. E. of La Grita. The southern and eastern limits stretch to the southward of the snowy mountains of Merida, across the ravine of Lavellaca, at the eastern foot of Paramo de las Rosas, toward the sources of the Rio de Tocuyo, and thence, between the mouth of the Rio de Motatan and the town of Carora, towards the Caño Oribono, as we have just stated, in describing the boundaries of the provinces of Varinas and Caraccas. The most western part of the *Gobierno* of Maracaybo, which comprehends Cape la Vela, is called the *Provincia de los Guajiros* (Guahiros), on account of the wild Indians of that name by whom it is inhabited, from the Rio Socuyo, as far as the Rio Calancala. The independent tribe of the Cocinas is found toward the south. Towns: Maracaybo, Gibraltar, Truxillo, Merida, San Faustino.

B.) ANCIENT VICEROYALTY OF NEW GRENADA,

comprehending New Grenada, properly so called, (Cundinamarca) and Quito. The western limits of the provinces of Maracaybo, Varinas, and Guayana, bound the territory of the viceroyalty on the east: the frontiers on the south and west are those of Peru and Guatemala. We shall only add here, in order to rectify the errors of the maps, that the Valle de Upar, or Villa de Reyes, Salazar de las Palmas, El Rosario de Cucuta, celebrated as the residence of the constituent assembly of Columbia, in the month of August 1816, San Antonio de Cucuta, la Grita, San Christoval, and la Villa de Arauca, as also the confluence of the Casanare and the Meta, the Inirida and the Gaviare, belong to New Grenada. The province of Casanare, dependent on Santa Fe de Bogota, extends towards the north beyond the Ori-

vante. On the north-east, the easternmost province of New Grenada, called *Provincia del Rio Hacha*, is separated by the Rio Enea from the province of Santa Marta. In 1814 the Rio Guaytara divided the province of Popayan from the presidency of Quito, to which belonged the province of Los Pastos. The isthmus of Panama and the province of Vera-gua have at all times been dependent on the Audiency of Santa Fe.

PERU. In estimating the extent of the present Peru at 41,500 square leagues (20 to a degree), the eastern boundary is, first, the course of the Rio Javary, from 6° to $9\frac{1}{2}^{\circ}$ south latitude; secondly, the parallel of $9\frac{1}{2}^{\circ}$, stretching from the Javary towards the left bank of the Rio Madeira, and cutting successively other tributary streams of the Amazon, namely, the Jatahy (Hyutahy), the Jurura, the Tefe, which appears to be the Tapy of Acuña, the Coary, and the Puruz; thirdly, a line which first runs up the Rio Madeira, and then the Mamorè, since called the Salto de Theotino, as far as the Rio Maniqui*, between the confluence of the Guaporè (Ytonamas of the Jesuits) and the mission of S. Ana, (about $12\frac{1}{2}^{\circ}$ south latitude); fourthly, the course of the Maniqui towards the west, and in stretching a line to the Rio Beni, which geographers believed to be a tributary stream, sometimes of the Rio Madeira, and sometimes of the Rio Puruz; fifthly, the right bank of the Rio Tequeari, which flows into the Beni, below the Pueblo de Reyes, and the sources of the Tequieri; a line

* See a scarce map of the *Misiones de Mojos de la Compania de Jesus*, 1713. The Rio Maniqui, to which modern geographers have given so much importance, by the fable of the lake Rogagualo, and the bifurcations of the Beni, joins the Yacuma, by which Mr. Haenke went from *Pueblo de Reyes* to the Rio Mamore.

which crosses the Rio Ynambari, stretches on the south-east towards the lofty Cordilleras * of Vilcaonota and Lampa, and separates the Peruvian districts of Pancartambo and Tinta from the district of Apolobamba, and the basin of the lake of Titicaca (Chucuito) ; sixthly, from the 16° of south latitude, the western chain of the Andes, bordering the basin of the lake of Titicaca, towards the west, and dividing by the parallel of 20° the tributary streams of the Desaguadero from the small Laguna of Paria, and those of the Rio Pilcomayo from the torrents that throw themselves into the South Sea. According to these limits, Peru on the north (as far as the Javary), is 200 leagues in width, and as far as the Rio de la Madeira and Mamorè, 260 leagues in the direction of the parallels of latitude ; while towards the southern extremity of the country, its mean breadth is not more than from 15 to 18 leagues. The partido of Tarapaca (in the intendancy of Arequipa) reaches the desert of Atacama, or the mouth of the Rio de Loa, which is placed by the expedition of Malaspina in 21° 26' south latitude, and forms the line of demarkation between Peru and the viceroyalty of Buenos Ayres. In detaching from Peru the four intendancies of La Paz, Charcas or La Plata, Potosi, and Cochabamba, there have been subjected to a government stationed on the banks of La Plata, not only the provinces where the waters flow towards the south-east, and the vast regions in which arise the Ucayale and the Madeira (tributary streams of the Amazon), but also the inland system of rivers, which, on the summit of the Andes, and in a longitudinal valley, terminated at its two extremities by the *clusters of mountains*

* The *Partidos* of Paucartambo and Tinta, belong to the intendancy of Cuzco. The district of Apolobamba and the basin of the lake of Titicaca, pertain to the ancient viceroyalty of Buenos Ayres.

of Porco and Cuzco, swell the alpine lake of Titicaca. Notwithstanding these arbitrary divisions, the associations of the Indians who inhabit the banks of that lake, and the cold regions of Oruro, La Paz, and Charcas, are oftener directed towards Cuzco, the centre of the ancient grandeur of the empire of the Incas, than towards the plains of Buenos Ayres. The table-land of Tiahuanacu, where the Inca Mata-Capac discovered buildings and gigantic statues, of which the origin extended back beyond the foundation of Cuzco, has been detached from Peru. To attempt thus to efface the historical remembrances of nations, is to call Greece by the name of the banks of the lake Copais. It is probable that in the numerous confederations of states which are forming in our days, the lines of demarkation will not be solely regulated by the course of the waters, but that in fixing them the moral interests of nations will at the same time be consulted. The partition of Upper Peru must be regretted by all who know how to appreciate the importance of the native population on the table-lands of the Andes. If a line be drawn from the southern extremity of the province of Maynas, or the banks of the Guallaga, to the confluence of the Apurimac and the Beni (which confluence gives birth to the Rio Ucayale), and thence to the westward of the Rio Vilcabamba, and the table-land of Paucartambo, towards the point where the south-east frontier cuts the Rio Ynambari, it will divide Peru into two unequal parts; one (of 26,220 square leagues), is the centre of the civilized population, the other (of 15,200 square leagues), is wild, and almost entirely uninhabited.

BUENOS AYRES. The editors of the excellent periodical work entitled *El Somanario* (vol. i, p. 111), justly observe, that even on the banks of La Plata no one knows the real limits of the ancient viceroyalty of Buenos Ayres. Between the Parana and the Rio Paraguay, between the sources of the

latter river and the Guaporè, which is a tributary stream of the Madeira, the boundaries are disputed by the Portuguese ; and it is uncertain if they ought to be extended on the south beyond the Rio Colorado as far as the Rio Negro, which receives the waters of the Rio del Diamante (*Abeja Argentina* 1822, N° 1, p. 8, and N° 2, p. 55). Amidst these uncertainties, which are augmented by the partition of Paraguay and the *Cisplatine Province*, I have calculated the dimensions of the vast territory of the viceroyalty, according to the limits traced on the Spanish maps before the revolution of 1810. Those limits are, on the east, the *Marco*, a little to the northward of the fort of Santa Teresa, at the mouth of the Rio Tahym ; from thence they stretch to the N. N. W. by the sources of the Ibicuy and of the Juy (cutting the Uruguay in latitude $27^{\circ} 20'$) to the confluence of the Parana and the Yguazu ; on the north along the left bank of the Parana as far as $22^{\circ} 42'$ south lat. ; on the N. W. following the Ivineima, towards the presidency of Nova Coimbra (lat. $19^{\circ} 55'$), founded in 1775 ; on the N. N. W. near Villa Bella and the isthmus which separates the waters of the Aguapchy (a tributary of the Paraguay) and those of the Guaporè towards the junction* of the latter river with the Mamorè, below the fort of Principe ($11^{\circ} 54' 46''$ south lat.) ; on the S. W. ascending the Mamorè and the Maniqui, as we stated above when we traced the limits of Peru and the viceroyalty of Buenos Ayres. Between the $21^{\circ} 26'$ and $25^{\circ} 54'$ of south lat. (between the Rio de Loa and Punta de Guacho), the territory of the viceroyalty reaches beyond the Cordillera of the Andes, and occupies for a distance of ninety leagues the coast of the South Sea. Here lies the desert of Atacama, in which is situated the small port of Cobija, which might

* P. 40.

be so useful for the exportation of the productions of the Sierra, or of Upper Peru. On the west, the western chain of the Andes, as far as 37° of latitude; and on the south the Rio Colorado, called also Desaguadero de Mendoza (lat. $39^{\circ} 56'$), or, according to the most recent authorities, the Rio Negro, separate Buenos Ayres from Chili and the Patagonian coast:

As Paraguay, the province *Entre Rios*, and *Banda Oriental* or the *Cisplatine Province* * may possibly remain separated from the state of Buenos Ayres, I have thought it right to calculate separately the contents of these countries in dispute. I have found in the limits of the ancient viceroyalty, between the Sea and the Rio Uruguay, 8960 square marine leagues; between the Uruguay and the Parana (Provincia entre Rios) 6848 square leagues; and between the Parana and the Rio Paraguay (the province of Paraguay properly so called) 7424 square leagues. These three parts on the east of the Rio Paraguay, from New Coimbra as far as Corrientes, and on the east of the Rio Parana, from Corrientes as far as Buenos Ayres, form a space of 23,232 square leagues †, nearly half as large again as France. I find consequently, for the three parts of which the ancient viceroyalty of Buenos Ayres is composed, including 18,300 square leagues of *pampas*, or savannahs:

Northern district, or Upper Peru,

from Tequieri and Mamorè, as

far as Pilcomayo, between 13

and 21 degrees of south lat. 37,020 sq. marine leagues

* The extent of territory comprised between the sea, the Rio de la Plata, the Uruguay, the Missions, and the Brazilian captaincy of Rio Grande. (*Auguste de Saint-Hilaire, Aperçu d'un voyage dans l'intérieur du Bresil*, 1823, p. 1.)

† Nearly 36,300 square leagues, 25 to a degree, and not 50,263 of these leagues, as the journals of Buenos Ayres assert.

Western district, or the country
 between Pilcomayo, Paraguay,
 the Rio de la Plata, the Rio
 Negro, and the Cordillera of
 the Andes (Tarija, Jujuy, Sal-
 ta, Tucuman, Cordova, Santa-
 Fe, Buenos Ayres, San Luis de
 la Punta and Mendoza) 66,518 sq. marine leagues

Eastern district, that is, all on the
 east of the Rio Paraguay and
 the Parana 23,232

126,770

The government of Buenos Ayres might partly find a compensation for the losses with which it is menaced on the north-east, by clearing a territory of 5054 square leagues, situated between the Rio Colorado and the Rio Negro. The Patagonian plains as far as the Straits of Magellan, present more than 31,206 square leagues, of which nearly two thirds are in a much more temperate climate than is generally supposed.

In that part of the viceroyalty occupied by the Brazilians on the east of the Uruguay, we must distinguish* between the limits recognized before the occupation of the *Province of the Missions*, on the north of the Rio Ibicuy, in 1801, and the boundaries established by the treaty concluded in 1821, between the Cabildo de Montevideo and the Captain-generalship of Rio Grande. The *Province of the Missions* is contained between the left bank of the Uruguay, the Ibicuy, the Toropi, a tributary stream of the latter, the Sierra de Saint Xavier, and the Rio Juy (a tributary stream of the Uruguay). Its

* These statements are founded on the manuscript notes which Mr. Auguste de Saint-Hilaire collected on the spot.

territory extends even beyond the Juy, towards the plains where the most northern mission of San Angel is placed; farther on, are forests inhabited by independent Indians. When, in consequence of the alliance between Spain and France, England, in February 1801, made the Portuguese declare war against Spain, the Spanish province of the Missions was easily invaded. The hostilities did not last long; and although the court of Madrid disputed the legality of the occupation, the Missions remained in the hands of the Portuguese. The treaty of 1777 ought to constitute the basis of the limits between the viceroyalty of Buenos Ayres, and the captain-generalship of Rio Grande. Those limits were formed by a line extending first to the Rio Guaray (the Guaney of Arrowsmith), and the sources of the small rivers Ibirapuita, Nanday and Ibycuimerim, that empty themselves into the Ibicuy, (lat. $29^{\circ} 40'$) at the confluence of the Rio de Ponche Verde with the Ibicuy, then continuing towards the south-east, to the source of the Rio Negro, (a tributary stream of the Uruguay), it crosses the lake Merin, towards the mouth of the Itahy, vulgarly called *Tahym*. The most southern Portuguese *marco* is found at the mouth of this river, on the sea coast. The country between the *Tahym* and the Rio Chuy, a little north of Santa Teresa, was neuter, and bore the name of *Campos neutraes*; but, notwithstanding the diplomatic conventions, it was in 1804 already occupied for the most part by Portuguese cultivators. The invasion of Spain by the French, and the revolutions of Buenos Ayres, have given the Brazilians facility to push their conquests as far as the mouth of the Uruguay, so that the new interior limits, between antient Brazil and the countries recently occupied, were fixed in 1821, without the intervention of the congress of Buenos Ayres, by the deputies of the *cabildo* of Montevideo, and of the captain-generalship of Rio Grande. It was agreed that the *Cisplatine Province* of Brazil (the *Oriental Band*, according to the geo-

graphic nomenclature of the Spaniards), should be bounded on the north by the confluence of the Uruguay with the Arapay (Ygarupay of Arrowsmith); on the east by a line which, beginning at Angostura, 6 leagues south of Santa Teresa, passes by the marsh of Saint Michel, follows the Rio San Luis as far as its mouth in the lake Merin, stretches along the western bank of that lake, at a distance of 800 toises, passes by the mouth of the Rio Sabuaty, goes up to that of the Rio Jaguarao, and following the course of this river as far as Cerros de Angona, crosses the Rio Negro, and continuing a curve at the north-west, rejoins the Rio Arapuy. The space comprehended between the Arapuy and the Ibicuy, the southern limit of the province of the Missions, belongs to the captain-generalship of Rio Grande. The Portuguese Brazilians have not yet attempted to form settlements in the province *Entre Rios*, (between the Parana and the Paraguay), a country devastated by Artigas and Ramirez.

In the savannahs (*pampas*), which, like an arm of the sea, extend from Santa-Fe on the north, between the mountains of Brazil, and those of Cordova and Jujuy*, the natural limits of the intendancies of Potosi and Salta, that is of Upper Peru and Buenos Ayres, seem likely to be altogether confounded. Chichas and Tarija are considered as the most southern provinces of Upper Peru; the plains of Manso between Pilcomayo and the Rio Grande, or Vermejo†, as well

* This town, according to M. Redhead (*Memoria sobre la dilatacion del aire atmosferico*; Buenos Ayres, 1819, p. 8 and 10), is situated 700 toises above the level of the sea. The absolute height of the town of San Miguel del Tucuman is, according to the barometric measurement of the same author, (an inhabitant of Salta) 260 toises.

† The real name of this river, the banks of which were heretofore inhabited by the Abipons, is Rio Iñate. (See Dobrizhofer, *Hist. de Abiponibus*, 1784, Tom. ii, p. 14).

as Jujuy, Salta, and Tucuman, belong to Buenos Ayres, properly so called. The limit of Upper Peru is now, on the east, only an imaginary line traced across uninhabited savannahs. It cuts the Cordillera of the Andes at the tropic of Capricorn, and thence crosses, first, the Rio Grande, 26 leagues below San Yago de Cotagayta; then the Pilcomayo, 22 leagues below its confluence with the Cachimayo, which flows from la Plata or Chuquisaca; and, finally, the Rio Paraguay, in the $20^{\circ} 50'$ of south latitude. If the basin of the lake of Titicaca, and the mountainous part of Upper Peru, where the language of the Inca prevails, were to be reunited to Couzco, the plains of Chiquitos and Chaco might still form a part of the government of the Pampas of Buenos Ayres.

CHILI. The limits of Chili on the north are the desert of Atacama, on the east the Cordillera of the Andes, where the road of the couriers passes between Mendoza and Valparaiso, at the height, according to barometric measures taken in 1794 by M. d'Espinosa and Bauza, of 1987 toises* above the level of the sea. I took for the southern limit† the entrance of the gulf of Chiloë, where the fort of Maullin (lat. $41^{\circ} 43'$) is the most southern possession of Spanish America on the continent. The bays of Ancud and Reloncavi no longer present any fixed settlements of European colonists; there begin the Juncos, who are independent, not to say wild Indians. From these statements it results, that the European settlements extend much farther to the south,

* This is, however, 440 toises less than the culminant point of the road of Assuay, between the towns of Quito and Cuenca, of which I took the level in 1802. See my *Obs. astron.* Tom. i, p. 312, No. 209.

† Political Essay on New Spain, vol. i, p. 6; vol. iv, p. 285.

on the western, than on the eastern coast of the continent ; the former have already passed a degree of latitude beyond the parallel of the Rio Negro and the Puerto de San Antonio. The capital of Santiago, of Chili, is situated on a table-land of the same elevation as the town of Caraccas*.

BRAZIL. The southern limits of Columbia, the eastern limits of Peru, and the northern limits of Buenos Ayres, determine the boundary of the Brazilian territory on the north, the west, and the south. In order to calculate the superficial contents, I employed manuscript maps, which were communicated to me by the government of Rio Janeiro, at the time when the very vague terms of the 8th article of the treaty of Utrecht, and the 107th article of the act of the Congress of Vienna†, had given rise to diplomatic

* 409 toises, according to Mr. Bauza, which is three hundred toises lower than the town of Mendoza, at the opposite declivity of the Cordillera of the Andes. (*Manuscript notes of Don Luis Neo, botanist of the expedition of Malaspina.*)

† See above, vol. v, p. 842. The Brazilian limits, in the government of the Rio Negro, were examined by the astronomers José Joaquim Victorio da Costa, José Simoens de Carvalho, Francisco José de Lacerda, and Antonio Luiz Pontes ; and in the government of Grand Para, especially between the Araguari and the Calsoene (Rio Carsewens of the *Map of the Coast of the Guyana*, published by the Depot of the Marine in 1817), by the astronomer Jozé Simoens de Carvalho, and the Colonel of Engineers Pedro Alexandrino de Souza. The French have long extended their pretensions beyond the Calsoene, near Cape Nord. The boundary is now thrown back as far as the mouth of the Oyapok. The principal tributary stream of that river, the Canopi, and the Tamouri, which is a tributary stream of the Canopi, draw near each other at a league distant (lat. 2° 30' ?)

disputes respecting the French and Portuguese Guyanas. By drawing a line from north to south, by the mouth of the

from the source of the Maroni, or rather from one of its branches, the Rio Araoua, near the village of the Aramichaun Indians. The Portuguese being desirous of tracing the limits between the Oyapok and the Araguari (Araouari), caused the latitude of the source of the latter river to be carefully examined by Colonel de Souza ; it was found to be further north than the mouth, which has placed the frontier in the parallel of Calsoene. The name of the Rio de Vicente Pinçon, become celebrated in the annals of diplomatic disputes, has disappeared on the new maps. According to an ancient manuscript Portuguese map in my possession, and where the coast is marked between San Josè de Macapa and the Oyapok, the Pinçon must be identical with the Calsoene. I suspect that the unintelligible terms of the 8th article of the treaty of Utrecht (" the line of the river *Japoc* or *Vincente Pinçon*, which ought to cover the possessions of the cape and of the north") are founded on the denomination of Cape North, sometimes given to Cape Orange. (See *Laet Nov. Orb.* 1633, p. 636). M. de la Condamine, whose sagacity nothing escapes, has already said, in the *Relation de son Voyage à l' Amazone*, p. 199, " the Portuguese have their reasons for confounding the bay (?) of Vincent Pinçon, near the western mouth of the Rio Arawari (Araguari), lat $2^{\circ} 2'$, with the river Oyapok, $4^{\circ} 15'$ lat. The peace of Utrecht makes it one river." This latitude $2^{\circ} 2'$ would bring the imaginary river of Pinçon near the Majacari and the Calsoene, and remove it nearly one degree from the Araguari, which is in lat. $1^{\circ} 15'$. Mr. Arrowsmith, whose map furnishes excellent materials for tracing the mouth of the Amazon, places the Rio de Vicente Pinçon on the south of Majacaré, where the Matario loses itself in a bay, opposite which the small isle Tururi is situated, lat. $1^{\circ} 50'$. As the Araguari, communicating with the Matario,

river of the Tocantins, and following the course of the Araguay, 40 leagues to the west of Villaboa, towards the point where the Rio Parana cuts the tropic of Capricorn, we divide Brazil into two parts. That on the west comprehends the captain-generalship of Grand Parà, Rio Negro, and Matto Grosso ; it is almost wholly uninhabited, and contains European settlements only on the banks of rivers, on those of the Rio Negro, Rio Branco, the Amazon, and the Guaporè, which unites with the Rio Madeira. It is 138,156 square leagues in extent (20 to a degree), while the eastern part, comprehending the captain-generalship of the coast, Minas-Geraes, and Goyaz, is 118,830 square leagues. My estimates are conformable to those of a very distinguished geographer, M. Adrien Balbi, who computes 2,250,000 square Italian miles (250,000 square marine leagues), for the whole Brazilian empire, excluding as I have done, the Cisplatine province and that of the Missions, on the east of the Uruguay. (*Essai statistique sur le Portugal*, tom. ii, p. 229.)

UNITED STATES. I have already remarked in another place (*Political Essay*, Vol. i, p. 13), that it became difficult to estimate the surface of the territory of the United States, in square leagues, since the acquisition of Louisiana, of which the northern and eastern boundaries long remained undetermined. They are now fixed by the convention concluded in London, October 20th, 1818, and by the treaty of the Floridas, signed at Washington, February 22d, 1819. I have therefore thought I might make this question the subject of fresh researches. I have devoted myself to this task with the greater care, as the surface of the United States

forms a sort of delta on the north-west around the inundated lands of Carapaporis, M. de la Condamine perhaps considered the small river which flows opposite the isle Tururi as the western branch of the Araguari.

from the Atlantic Ocean to the Pacific is estimated by very recent authors at 125,400, at 137,300, at 157,500, at 173,400, at 205,500, and at 238,400 square marine leagues, 20 to a degree : and it appeared to me impossible from those varying statements, of which the difference amounts to more than 100,000 square leagues, that is to six times the *superfices* of France, to find a result with which we might compare the surfaces of the new free states of Spanish America. In some instances the same author has, at different periods, given very different estimates of the same territory, bounded by the two seas between Cape Hatteras and the Rio Columbia, between the mouth of the Mississippi and the lake des Bois. Mr. Mellish, in his map of 1816, has estimated the United States at 2,459,350 square miles (69.2 to a degree), of which the territory of the Missouri alone is made 1,580,000. In his *Travels through the United States of America*, 1818, p. 561, he fixes the contents at 1,833,806 square miles, of which the territory of the Missouri is estimated at 985,250. Still later, in his *Geographical description of the United States*, 1822, p. 17, he again increases the calculation to 2,076,410 square miles. These fluctuations of opinion respecting the extent of the surface of the United States cannot be attributed to the various ways in which the limits are traced : the errors for the most part which affect the extent of the territory between the Mississippi and the Rocky Mountains, and between those mountains and the coast of the Pacific, arise from mere mistakes of calculation. I find in taking the average of several estimates, on the maps of Arrowsmith, Mellish, Tardieu, and Brué :—

Square Marine
Leagues.

- I. On the east of the Mississippi..... 77,684
or 930,000 square miles.
- a.) Atlantic part, east of the Alleghanis 27,064
or 324,000 square miles. The chain

of the Alleghanis has been prolonged on the north towards Plattsbourg and Montreal, and on the south by following the Apalachicola, so that the greater part of Florida belongs to this Atlantic division.

b.) Between the Alleghanis and the Mississippi 50,620
or 606,000 square miles.

II. On the west of the Mississippi 96,622
or 1,156,800 square miles.

a.) Between the Mississippi and the Rocky Mountains, comprehending the lakes 72,531
or 868,400 square miles.

b.) Between the Rocky Mountains and the coast of the Pacific, taking for the southern and northern limits the parallels 42° and 49° (Western Territory). 24,091
or, 288,400 square miles.

Territory of the United States, between the two Oceans, 2,086,800 square miles, or...174,306 square marine leagues, of 20 to a degree.

The whole territory of the United States, from the Atlantic Ocean to the Pacific, is consequently a little larger than Europe, to the westward of Russia. The Atlantic part alone may be compared to Spain and France united; the district between the Alleghanis and the Mississippi, to Spain, Portugal, France, and Germany; the portion westward of the Mississippi, to Spain, France, Germany, Italy, and the Scandinavian kingdoms. The Mississippi consequently divides the United States into two great portions, of which the former, or eastern division, advancing rapidly in culture and civilization,

contains a superficial extent equal to that of Mexico ; and the latter, the western division, almost entirely wild and unpeopled, a territory as large as that of the republic of Columbia.

In the statistical researches which have been prosecuted in several countries of Europe, important consequences have been drawn from the comparison of the relative population of the maritime and inland provinces. In Spain* these relations are to one another as 9 to 5 ; in the United Provinces of Venezuela, and, above all, in the ancient captain-generalship of Caraccas, they are as 35 to 1. How powerful soever may be the influence of commerce on the prosperity of states, and the intellectual development of nations, it would be wrong to attribute in America, as we do in Europe, to that cause alone the differences we have just remarked. In Spain and Italy, if we except the fertile plains of Lombardy, the inland districts are arid, filled with mountains, or high table-lands ; the meteorological circumstances on which the fertility of the soil depends, are not the same in the lands bordering on the sea as they are in the central provinces. Colonization in America has generally begun on the coast, and advanced slowly

* *Antillon, Geografia astronomica, natural y politica, 1815,*
p. 145.

towards the interior ; such is its progress in Brazil and in Venezuela. It is only where the coast is unhealthy, as in Mexico and New Grenada, or sandy and exempt from rain as in Peru, that the population is concentrated on the mountains, and the table-lands of the interior. These local circumstances are too often overlooked in discussing the future fate of the Spanish colonies ; they communicate a peculiar character to some of those countries of which the physical and moral analogies are less striking than is commonly believed. Considered with reference to the distribution of the population, the two provinces of New Grenada and Venezuela, which have been united in one political body, present the most complete contrast. Their capitals (and the position of capitals always denotes in what district the population is most concentrated) are situated at such unequal distances from the trading coasts of the Caribbean sea, that the town of Caraccas, to be placed on the same parallel with Santa-Fe de Bogota, must be transplanted towards the south, to the junction of the Oroonoko with the Guaviare, where the mission of San Fernando de Atabapo is situated.

The republic of Columbia, is, with Mexico and Gautimala, the only state of Spanish America which occupies the coast opposite to Europe, as well as that which is opposite to Asia.

There are 400 leagues from Cape Paria to the western extremity of Veragua; and 260 from Cape Burica to the mouth of Rio Tumbez. The shore possessed by the republic of Columbia consequently equals in length the coast from Cadiz to Dantzick, or from Ceuta to Jaffa. This immense resource for national industry is combined with a degree of cultivation of which the importance has not hitherto been sufficiently recognized. The isthmus of Panama forms a part of the territory of Columbia, and that neck of land, traversed by five roads, and stocked with camels, may one day serve as a *portage* for the commerce of the world, even though neither the plains of Cupica, the bay of Mandinga, nor the Rio Chagre, should ever present the possibility of a canal fit for the passage of vessels going from Europe to China*, or from the United States to the north-west coast of America.

In the course of this work, when considering the influence which the *configuration* of countries (that is, the elevation and form of their coasts,) exerts in every district on the progress of civilization and the destiny of nations, I have often insisted on the disadvantages of those vast masses of triangular continents, which, like

* The ancient vice-royalty of Buenos-Ayres extended also along a small portion of the South Sea coast; but we have seen above (page 170), how desert is this portion.

Africa, and the greater part of South America, are destitute of gulfs and inland seas. We will not here dwell on the observation, that the existence of our Mediterranean has been closely connected with the first dawn of human cultivation among the nations of the west; and that the articulated form of the lands, the frequency of their contractions, and the concatenation of peninsulas, favoured the civilization of Greece, Italy, and perhaps of all Europe, to the westward of the meridian of the Propontis. In the New World the uninterruptedness of the coasts, and the monotony of their straight lines, are most remarkable in Chili and Peru. The shore of Columbia is more varied, and its spacious gulfs, such as that of Paria, Cariaco, Maracaybo, and Darien, were at the time of the first discovery better peopled than the rest, and facilitated the interchange of productions. That shore possesses an incalculable advantage in being washed by the Caribbean sea, a kind of inland sea with several outlets, and the only one pertaining to the New Continent. This basin, the different shores of which belong to the United States, the republic of Columbia, Mexico, and some maritime powers of Europe, gives rise to a peculiar system of trade, exclusively American. The south-east of Asia, with its neighbouring Archipelago, and above all, the state of the Mediterranean in the time of the

Phenician and Greek colonies, have proved the happy influence of the nearness of opposite coasts which have not the same productions, and are inhabited by nations of different races, on commercial industry and intellectual cultivation. The importance of the inland sea of the Antilles, bounded by Venezuela on the south, will be still augmented by the progressive increase of population on the banks of the Mississippi; for that river, the Rio del Norte and the Magdalena, are the only great navigable streams which it receives. The depth of the American rivers, their immense branches, and the use of steam boats, every where facilitated by the proximity of forests, compensate to a certain extent the obstacles arising from the uniform line of the coasts, and the general configuration of the continent, in the promotion of industry and civilization.

By comparing, according to the tables we have furnished above, the extent of the territory and the entire population, we should obtain the result of the connection of those two elements of public prosperity, a connection that constitutes the *relative population* of every state in the New World. We should find to every square marine league, at Mexico, 90; in the United States, 58; in the republic of Columbia, 30; and in Brazil, 15 inhabitants; while Asiatic Russia furnishes 11; the whole Russian

empire 87 ; Sweden with Norway, 90 ; European Russia*, 320 ; Spain, 763 ; and France, 1778. But these estimates of relative population, when applied to countries of immense extent, and of which a great part is entirely uninhabited, furnish mathematical abstractions that afford little instruction. In countries uniformly cultivated,

* The superficial extent of European Russia, without Finland and the Grand Duchy of Warsaw, was in 1805, according to the statistical tables of Mr. Hassel (*Umriss der Europ. Staaten*, Tom. 1, p. 10), 138,000 square leagues, 20 to a degree, with a population of 36,400,000 souls ; according to the same tables, the extent of the whole Russian monarchy was 603,160 square leagues, with 40 millions of population. These estimates of 1805 would give but 264, and 66 inhabitants to the square league. In supposing with Mr. Balbi (see his interesting researches on the population of Russia, in the *Compendio di Geografia universale*, pp. 143, and 163, and the *Statistical Essay on Portugal*, Vol. ii, p. 253), the superficial extent of European Russia with Finland and the kingdom of Poland, to be 169,400 square leagues, the *superfices* of the whole Russian monarchy in Europe and in Asia, 686,000 square leagues, and the actual population in 1822 to be from 48 to 54 millions, we find 283 and 78 *inhabitants to the square league*. According to researches which I have recently made relative to the extent of Russia, I fix, for the whole empire, comprehending Finland and Poland, 616,000 square leagues ; for the European part, comprehending the ancient kingdoms of Kasan and Astrakhan, with the exception of the government of Perme, 150,400 square leagues, which yields the relative population of 318 and 87, stated in the text. (See also *Gaspari, Vollst. Hand. der Erdb. B. xii, p. 210.*

in France * for instance, the number of inhabitants to the square league, calculated by separate departments, is generally only a third, more or less, than the relative population of the sum of all the departments. Even in Spain, the oscillations from the average number rise, with a few exceptions, only from the half to the double†. In America, on the contrary, it is only in the Atlantic states, from South Carolina to New Hampshire, that the population begins to spread itself with some uniformity. In that most civilized portion of the New World, from 130 to 900 inhabitants are reckoned to the square league, while the relative population on all

* The superficial extent of France, not comprehending Corsica, was estimated by the direction of the Cadastre, in 1817, at 51,910,062 hectares, or 5190 square myriameters, or 26,278 square leagues, 25 to a degree. M. Coquebert de Montbret reckons 442 square leagues for Corsica; consequently France with Corsica now contains 26,720 common square leagues, or 17,101 square leagues (20 to a degree). The population in 1820, having been 30,407,907, we find 1778 inhabitants to every square marine league. The average extent of a department of France is 198 square marine leagues; the *mean* population is 353,600. The number of inhabitants to the square league is, in most of the departments, 1000, 1200, 2400, and 2600. In taking the average of the five most and least peopled departments and governments of France and Russia, we obtain the proportion of the minimum and maximum of the relative population; in the former of these countries = 1 : 3,7; in the latter = 1 : 12,2.

† *Antillon, Geografia*, p. 141.

the Atlantic states, considered together, is 240. The extremes (North Carolina and Massachusetts) are only in the relation of 1 to 7, nearly as in France*, where the extremes, in the department of the Upper Alps and of the North, are also in the relation of 1 : 6,7. The oscillations from the mean number, which we generally find restricted to narrow limits in the civilized countries of Europe†, exceed, so to speak, all

* In continental France, excluding Corsica; for the department of the Liamone is still worse peopled than that of the Upper Alps. The department of the North had, in 1804, on 178 square leagues (20 to a degree) a population of 774,500; and in 1820, of 904,500. The department of the Upper Alps had, in 1804, on 160 square leagues, a population of 118,322, and in 1820, of 121,400. There are, therefore, in these two departments, 5082, and 758 inhabitants to the square league.

† *Europe*, bounded by the Jaik, the mountains of the Oural and the Kara, contains 304,700 square marine leagues. In supposing the inhabitants to be 195 millions, a relative population is formed of 639 to the square league, a little less than that of the department of the Upper Alps, and a little more than that of the inland provinces of Spain. In comparing the *total mean* of 639 with the *partial mean* of European countries that do not contain less than 600 square leagues, we obtain, excluding Laponia only, and four governments of Russia (Archangel, Olonez, Wologda, and Astrakhan), 160 for the most desert regions of Europe; and for the most peopled, 2400 souls to the square league. These numbers give the relation of the extremes = 1 : 15. *America* contains, according to my last calculations, 1,184,800 square marine leagues, from Cape Horn to the 68° of north

measure in Brazil, in the Spanish colonies, and even in the confederation of the United States, when considered in its whole extent. We find in some intendances in Mexico (La Sonora and

lat., comprehending the West Indies ; and in estimating the population as we have done above, at 34,284,000, we scarcely obtain 29 inhabitants to the square league. Now to find a continuous surface of 600 square leagues, and which is at the same time the most peopled of all America, we must have recourse to a part of the table-land of Mexico, or of New England, where three contiguous states, Massachusetts, Rhode Island, and Connecticut, contained in 1820, an entire population of 881,594, on 12,504 square English miles, consequently nearly 840 souls to the square marine league. We can only select among the West India Islands, of which the population is extremely concentrated, the Great Antilles ; for the Little Antilles (or the Eastern Caribbean Isles), from Culebra and St. Thomas to Trinidad, contain altogether but 387 square leagues. Jamaica has nearly the same relative population as the three states of New England, which we have just mentioned ; but its surface does not extend to 500 square leagues. St. Domingo (Haïti), which is five times larger than Jamaica, has only 266 inhabitants to the square league. Its relative population scarcely reaches that of New Hampshire. I shall not venture to indicate the fraction which we may suppose to be the *minimum* of the relative population of the New World ; for instance, in the savannahs between the Meta and the Guaviare, or in Spanish Guyana, between the Esmeralda, the Rio Erevato, and the Rio Caura, or finally, in North America, between the source of the Missouri and the Slave Lake. It is probable that the relation of the extremes, found in Europe to be as 1 : 15, is, in the New World, even excluding the Llanos or Pampas, at least 1 : 8000.

Durango) from 9 to 15 inhabitants to the square league, while in others, on the central tableland, there are more than 500. The relative population of the country situated between the eastern bank of the Mississippi and the Atlantic states is scarcely 47, while that of Connecticut, Rhode Island, and Massachusetts is more than 800. On the west of the Mississippi, as well as in the interior of Spanish Guyana, there are not 2 inhabitants to the square league on much larger extents of territory than Switzerland or Belgium. The state of these countries is like that of the Russian empire, where the relative population of some Asiatic governments (Irkutsk and Tobolsk), is to that of the best cultivated European districts, as 1 to 300.

The prodigious difference which exists in countries newly cultivated, between the extent of territory and the number of inhabitants, renders it necessary to enter into these partial estimates. When we learn that New Spain and the United States, taking their entire extent at 75,000 and 174,000 square marine leagues, give respectively, 90 and 58 souls to each league, the idea we form of that distribution of the population, on which the political force of nations depends, is as little correct as that we should obtain of the climate of a country, that is, of the distribution of the heat in the different seasons, by the knowledge

solely of the mean temperature of the whole year*. If we take from the United States all their possessions west of the Mississippi, their relative population would be 121 instead of 58 to the square league, consequently much greater than that of New Spain; in taking from the latter country the *Provincias internas* (north and north-east of Nueva Galicia), we should find 190, instead of 90, souls to the square league.

The following are the particular statements

* It would be taking me too far from my subject to push this comparison farther, and discuss to what degree the whole of the means might throw light on the mode of distribution both of the temperature and of the population. I have endeavoured to prove in another place (*Des lignes isothermes*, pp. 62, and 71) that, in the system of European climates, the mean temperature of the winter begins to be below the point of congelation, only where the mean temperature of the whole year sinks at least 10° of the centigrade thermometer. The lower is the mean annual temperature, so much greater is the difference of temperature of the winter and the summer. In the same manner the very feeble relative population of a whole country, of considerable extent, generally indicates that state of dawning cultivation which produces great inequality in the distribution of the inhabitants. What Buffon, with that propriety of expression which characterizes his style, has called *extreme climates*, (the climates of the interior of continents where very severe winters succeed very hot summers,) corresponds in some measure with population unequally accumulated; and two phenomena of a nature entirely different, furnish, if we consider them as mere *quantitative* estimates, very remarkable analogies.

for Venezuela and New Grenada, according to the numbers which we have reason to believe to be the most exact :

Inhabitants
to the Sq.
Mar. Lea.

Republic of Columbia 30

Six times larger than Spain, nearly equal in extent to the United States, westward of the Mississippi. Superficial extent, 91,950 square leagues. Actual population, 2,785,000.

A. *New Grenada* (with the province of Quito) 34

Not quite four times the size of Spain. *Superficies*, 58,250 square leagues. Actual population, 2 millions.

B. *Venezuela*, or ancient *Capitania-general* of *Caraccas* 23

More than twice the size of Spain ; equal in extent to the *Atlantic States* of North America. *Superficies*, 33,700 square leagues. Actual population, 785,000.

a. *Cumana* and *Barcelona* 37

Superficies, 3515 square leagues : Actual population, 128,000.

b. *Caraccas* (with Coro)..... 81

Superficies, 5140 square leagues. Actual population, 420,000.

c. *Maracaybo* (with *Merida* and *Truxillo*) 40

Superficies, 3548 square leagues : Actual population, 140,000.

d. *Varinas* 28

Superficies, 2678 square leagues. Actual population, 75,000.

e. *Guyana* (Spanish *Guyana*)..... 2

Superficies, 18,793. Actual population, 40,000.

It results from this statement that the provinces of Caraccas, Maracaybo, Cumana, and Barcelona, that is, the maritime provinces of the north, are the best peopled of the ancient *Capitania-general*; but, in comparing this relative population with that of New Spain, where the two intendancies of Mexico and Puebla alone contain, on an extent scarcely equal to the *superficies* of the province of Caraccas, a greater actual population than that of the whole republic of Columbia, we see that the Mexican intendancies, which, with respect to the concentration of their culture, occupy but the 7th or 8th rank (Zacatecas and Guadalajara), contain more inhabitants to the square league than the province of Caraccas. The average of the relative population of Cumana, Barcelona, Caraccas, and Maracaybo, is 56; and, as 6200 square leagues, that is, one half of the extent of these four provinces, are almost desert steppes *, (*Llanos*,) we find, in reckoning the *superficies* and the feeble population of the steppes, 102 inhabitants to the square league. An analogous modification gives the province of Caraccas

* The superficial extent of the steppes of these four provinces is 6219 square leagues, 20 to a degree. The following statements may enable us to judge of the agricultural state of those districts in which the steppes present such great obstacles to the rapid progress of population. (Vol. vi. pp. 59—68.)

Province

alone, a relative population of 208, that is, only one-seventh less than that of the *Atlantic States* of North America.

As in political economy, numerical state-

Province of *Cumana* : Sq. Leagues

| | |
|--|-------|
| Mountainous part of the Cordilleras of the coast and Caripe | 393 |
| <i>Llanos, or savannahs</i> | 1558 |
| | <hr/> |
| | 1951 |

Of which the marshy delta of the Oroonoko is
652 sq. leagues.

Province of *Barcelona*:

| | |
|---|-------|
| The rather mountainous part, and the forests towards the North | 223 |
| <i>Llanos</i> | 1341 |
| | <hr/> |
| | 1564 |

Province of *Caraccas* :

| | |
|---|-------|
| Mountainous part | 1820 |
| <i>Llanos, comprehending Carora and Monai</i> | 3320 |
| | <hr/> |
| | 5140 |

These calculations yield 6219 square leagues of steppes, or savannahs, of which 130 are to the westward of the Rio Portuguesa. Now the *Llanos* of Varinas, between that river, the Apure, and the mountains of Pamplona, Merida, and Paramo de las Rosas, contain 1664 square leagues ; it thence results, that the immense basin of the *Llanos* comprehended between the Sierra Nevada de Merida, the delta of the *Bocas Chichas*, inhabited by the Guaraon Indians, and the northern banks of the Apure and the Oroonoko, present a *superficies* of 7753 square leagues, equal to half the extent of Spain. The actual population of the savannahs of Caraccas, Barcelona, and Cumana, appears to me, on account of their populous cities, to be now above 70,000 souls.

ments become instructive only by a comparison with analogous facts, I have carefully examined what, in the actual state of the two continents, might be considered as a small relative population in Europe, and a very great relative population in America. I have, however, chosen examples only among the provinces which have a continued surface of more than 600 square leagues, in order to exclude the *accidental accumulations* of population which are found around great cities; for instance, on the coast of Brazil, in the valley of Mexico, on the table-lands of Santa-Fe de Bogota and Couzco; or finally, in the small West India islands (Barbadoes, Martinico, and St. Thomas), of which the relative population is from 3000 to 4700 inhabitants to the square league, and consequently equal to the most fertile parts of Holland, France, and Lombardy.

MINIMUM OF EUROPE.

To the
Sq. Lea.

The four governments the least peopled of *Euro-
pean Russia* :

| | |
|-----------------------------|-----|
| Archangel | 10 |
| Olonez | 42 |
| Wologda and Astrakhan | 52 |
| Finland | 106 |

The province the least peopled of *Spain*, that of

| | |
|--------------|-----|
| Cuenca | 311 |
|--------------|-----|

The Dutchy of *Lunebourg*, (on account of the
heaths)

550

| | |
|--|------|
| The department of continental France the worst peopled, (Upper Alps) | 758 |
| Departments of France thinly peopled, (the Creuse, the Var, and the Aude) | 1300 |

MAXIMUM OF AMERICA.

| | |
|--|------|
| The central part of the intendancies of Mexico and Puebla*, above | 1300 |
| In the United States, Massachusetts, but having only 522 square leagues of surface..... | 900 |
| <i>Massachusetts, Rhode Island, and Connecticut</i> , toge- ther..... | 840 |
| The whole intendancy of Puebla..... | 540 |
| The whole intendancy of Mexico | 460 |
| These two Mexican intendancies together, are nearly a third of the superficial extent of France, with a suitable population (in 1823, nearly 2,800,000 souls), to prevent the towns of Mexico and Puebla from having a sensible in- fluence on the relative population. | |
| Northern part of the province of Caraccas, (with- out the Llanos) | 208 |

This table shews that those parts of America which we now consider as the best peopled, attain the relative population of the kingdom of Navarre, of Galicia, and the Asturias, which,

* Is there a part of the United States, from 600 to 1000 square leagues in extent, of which the relative population exceeds the *maximum* of New Spain, which is 1300 inhabitants to the square league, or 109 to the square mile, 69·2 to a degree? The relative population of Massachusetts, which is 75·5 to the square mile, and is regarded as very considerable,

after the province of Guipuscoa, and the kingdom of Valencia*, reckon the greatest number of inhabitants to the square league in all Spain ; the *maximum* of America is, however, below the relative population of the whole of France (1778 to the square league), and would in the latter country be considered as a very thin population. If on the entire surface of America we direct our views to the object which engages our special attention in this chapter, the *Capitania-general* of Venezuela, we find that the most populous of these subdivisions, the province of Caraccas, considered as a whole, with-

has hitherto led me to doubt this. In order to examine the question we must be able to compare the *superficies* of a certain number of bordering provinces with the registers of population published by the congress of Washington. The relative population of the States of New York, Pennsylvania, and Virginia, appear so small (240, 204, and 168, to the square marine league) only because in distributing the population uniformly over the whole extent of territory, we must include the regions partly desert, possessed by each state on the west of the Alleghanis, regions which have an influence on the total average, nearly in the same manner as the *Llanos* of Caraccas and Cumana. Egypt contains 11,000 square leagues, of which only 1408 are inhabited.

* We find in the kingdom of Valencia 1860, and in the Guipuscoa, 2009, to the square league ; but the latter province, containing only 53 square leagues, should be excluded, according to the principle which I have adopted in these researches. Galicia has an actual population of 1,400,000, and the kingdom of Valencia of 1,200,000.

out excepting the Llanos, has, as yet, only the relative population of Tennesée; and that this province, without the Llanos, furnishes in the northern part, on more than 1800 square leagues, the relative population of South Carolina. Those 1800 square leagues, the centre of agriculture, are twice as well peopled as Finland, but still a third less than the province of Cuenca, the least populous of all Spain. We cannot dwell on this result without a painful feeling. Such is the state in which colonial politics, and the folly of the public administration, have, during three centuries, left a country of which the natural riches may vie with all that is most wonderful on earth, that in order to find one equally desert, we must look either towards the frozen regions of the north, or to the westward of the Alleghani mountains, towards the forests of Tennessee, where the first clearings have only begun within the last fifty years!

The most cultivated part of the province of Caraccas, the basin of the lake of Valencia, vulgarly called *los Valles de Aragua**, counted, in 1810, nearly 2000 inhabitants to the square league; now, supposing a relative population three times less, and taking off from the whole surface of the *Capitania-general* nearly 24,000

* These vallies do not contain 30 square leagues of surface. See above, Vol. iv. p. 118.)

square leagues, as being occupied by the Llanos and the forests of Guyana, and therefore presenting great obstacles to agricultural labours, we should still obtain a population of 6 millions for the remaining 9700 square leagues. Those who, like me, have lived long beneath the fine sky of the tropics, will find nothing exaggerated in these calculations; for I suppose for the portion the most easily cultivated, a relative population equal to that which exists in the intendancies of Puebla and Mexico*, full of barren mountains, and extending towards the coast of the Pacific, over regions which are almost desert. If the territories of Cumana, Barcelona, Caraccas, Maracaybo, Varinas and Guyana, should one day be fortunate enough to enjoy good provincial and municipal institutions, as confederated states, they will not require a century and a half to attain a population of six millions of inhabitants. Venezuela, the eastern part of the *Republic of Columbia*, would not, even with nine millions, have a more considerable population than Old Spain; and how can it be doubted that that part of Venezuela, which is most fertile and easy of cultivation, that is, the 10,000 square leagues remaining, after excluding the savannahs (Llanos) and

* These two intendances contain however, together, 5520 square leagues, and a relative population of 508 inhabitants to the square marine league.

the almost impenetrable forests between the Oroonoko and the Cassiquiare, could nourish, under the fine sky of the tropics, as many inhabitants as 10,000 square leagues of Estramadura, the Castilles, and other provinces of the table-land of Spain. These predictions are by no means problematical, inasmuch as they are founded on physical analogies, and on the productive power of the soil; but in order to indulge the hope that they will be actually accomplished, we must be able to take into our reckoning another element less susceptible of calculation,—that national wisdom which subdues the hostile passions, stifles the germ of civil discord, and gives stability to free and energetic institutions.

PRODUCTIONS.—When we take a view of the soil of Venezuela and New Grenada, we perceive that no other country of Spanish America supplies commerce with such various and such rich productions of the vegetable kingdom. If we add the harvests of the province of Caraccas to those of Guayaquil, we find that the republic of Columbia can furnish alone nearly all the cocoa annually demanded by Europe. The union of Venezuela and New Grenada has also placed in the hands of one people the greater part of the cincona exported from the New Continent. The temperate mountains of Merida,

Santa-Fe, Popayan, Quito, and Loxa, produce the finest qualities hitherto known of this medicinal bark. I might swell the list of these valuable productions by the coffee and indigo of Caraccas, so long esteemed in commerce; the sugar, cotton, and flour of Bogota; the ipecacuanha of the banks of the Madelaine; the tobacco of Varinas, the *Cortex Angosturæ* of Carony; the balsam of the plains of Tolu; the skins and dried provisions of the Llanos; the pearls of Panama, Rio Hacha, and the Marguerita; and finally, the gold of Popayan, and the platina, which is no where found in abundance but at Choco and Barbacoas: but, in conformity to the plan I have adopted, I shall confine myself to the ancient *Capitania-general* of Caraccas. In the preceding chapters I have treated of each particular production; it therefore only remains to mention succinctly the statistical statements connected with that peaceful period which immediately preceded the political agitations of this country.

Cacao. Total production, 193,000 *fanegas* of 110 Spanish pounds, of which Venezuela exported (inclusive of the contraband trade) 145,000 *fanegas*. Total value, more than five millions of piastres. Number of trees in 1814, nearly 16 millions. This part of Terra Firma has hitherto derived its greatest celebrity from cacao: the cultivation of it diminishes in proportion as that of coffee, cotton, and sugar increases; it advances progressively from west to east. Ca-

cao is important, not merely as an object of external trade, but also as food for the inhabitants. The interior consumption will consequently increase with the population, and it is to be hoped that the proprietors of the cacao plantations will soon find new encouragement in the increase of national prosperity. (See above, Vol. iii, pp. 191—195; Vol. iv, pp. 231—242.) The cacao of the provinces of Caraccas, Barcelona, and Cumana, of which the finest quality is found at Uritucu (near San Sebastian), Capiriquai, and San Bonifacio, is far superior to the cacao of Guayaquil; it yields only to that of Soconusco (*Juarros, Compendio de la hist. de Guatimala*, 1818, Tom. ii. p. 77) and of Gualan, near Omoa, which scarcely enters into the commerce of Europe.

Coffee. The small table-lands of from 250 to 400 toises high, that are frequent in the provinces of Caraccas and Cumana (in the Cordilleras of the shore and of Caripe), contain temperate situations extremely favourable to this plant. When it had been cultivated only 28 years, in 1812, the produce amounted to nearly 60,000 quintals. (See, on the consumption of coffee in Europe, Vol. iv, pp. 65—72).

Cotton. That of the vallies of Aragua, Maracaybo, and the gulf of Cariaco, is of a very fine quality, but the average exportation was not more than $2\frac{1}{2}$ millions of pounds. (Vol. ii, pp. 69, 101, 191; Vol. iv, pp. 123—126; and *Urquinaona, Relacion de la Revol. de Venezuela*, 1820, p. 31.)

Sugar. Fine plantations were formed at the beginning of this century, in the vallies of Aragua and Tuy, near Guatiore and Caurimare; but the exportation was very trifling: (Vol. iv, pp. 83—86, and pp. 177—182). I have often in the course of this work directed the attention of the reader to the preponderance which the cultivation of colonial productions will progressively acquire in Spanish America over that of the smaller West India Islands.

Indigo. The growth of this very important article decreased much more from 1787 to 1798 than that of cacao. It is maintained with advantage only in the province of Varinas (for instance, between Mijagual and Vega de Flores), and on the banks of the Tichira. The value of the indigo of Caraccas amounted, in the most prosperous times, to 1,200,000 piastres. The exportation to La Guayra, in 1794, was 900,000 pounds, and in 1809, 7000 *zurrones*. (Vol. 1, pp. 62, 63 ; Vol. iv, pp. 119, 187.

Tobacco. The tobacco of Venezuela is not only very superior to that of Virginia, but yields in quality only to the tobacco of the island of Cuba and the Rio Negro. The establishment of the *royal farm* in 1777, has prevented the opening of this important branch of commerce to the trade of Varinas, and of the vallies of Aragua and Cumanacoa. The total produce of the sale of tobacco at the beginning of the 19th century, was 600,000 piastres. (Vol. i, p. 57 ; Vol. iv, p. 166, and Vol. v, p. 368.) When the king of Spain, during the ministry of Don Diego Gardoqui, declared, by his *cédula* of September 30, 1792, that he would consent to deliver the country of the *farm* (*estanco*), it was proposed to substitute a general capitation on the monopoly of the fabrication of brandy from the sugar cane, (*aguardiente de cana*) or other taxes not less vexatious. These projects failed, and the *farm* of tobacco was continued.

Cerealia. The eastern and western parts of Columbia are often contrasted with each other from very vague and imperfect notions of the localities ; it is affirmed that New Grenada is a country of mines and wheat, and that Venezuela is a country of colonial productions. In making these arbitrary distinctions the *tierra fria y templada*, is alone considered ; that is, the countries of which the mean temperature * of the

* Between 800 and 1600 toises above the level of the sea. It may appear surprising that in equinoctial America, coun-

year is 13, and 18·5, cent. (the great mountainous table-lands of Quito, Los Pastos, Bogota, Tunja, Velez, and Leyva), forgetting that the whole northern and western part of New Grenada is a low and humid country, enjoying a mean temperature of 26° to 28°, and consequently fitted for the productions which in Europe are exclusively termed colonial. Venezuela (and I always intend to designate by that name the territory * of the ancient *Capitania-general* of Caraccas), has

tries are called *cold*, of which the temperature of the year rises above that of Milan and Montpellier; but it must not be forgotten that in those cities the mean temperature of the summer is 22·8° and 24·3°; while at Quito, for instance, the days are generally during the whole year, between 15·6° and 19·3°, and the nights between 9° and 11°. The heat never rises beyond 22°; and the cold + 6° of the centigrade thermometer. The *tierras frias*, at the height of Santa-Fe (1365 toises), and Quito (1492 toises), have, during the whole year, the temperature of Paris in the month of May. As the division of heat at various times of the year is so different in the torrid and the temperate zones, in order to give an exact idea of the climate of any spot situated in the neighbourhood of the equator, the surest method is to compare it with the temperature of a month in the temperate region of Europe.

* The term Venezuela was employed in this sense at the installation of the congress at Angostura, February 15th, 1819, at which the deputies of Caraccas, Barcelona, Cumana, Varinas and Guyana were assembled. The maps of La Cruz and of Lopez use the terms, Province of Caraccas, and Venezuela, as synonymous. The captain-general, residing at Caraccas, and governing the country from the mouth of the Oroonoko as far as the Rio Tachira, was called *Capitan general de la Provincia de Venezuela y Ciudad de Caracas*. M. Depons, in his statistics, distinguishes the *Capitania-general* of Caraccas

also cold and temperate climates ; it is a *country of bananas and of wheat*. The *cerealia* of Europe are already cultivated on the mountains of Merida and Truxillo (at la Puerta, and near St. Ana, on the south of Carachi), in the vallies of Aragua, near Victoria, and of San Matheo, and in the country, somewhat mountainous, between Tocuyo, Quibor, and Barquesimeto, which forms the *ridge of partition* between the streams which unite with the Apure and the Oroonoko, and those which fall into the Caribbean Sea. It is a fact worthy of particular attention, that wheat is cultivated in several of these places at a height that does not exceed 270 to 300 toises above the level of the sea, amidst the cultivation of coffee-trees, sugar-cane, and in places where the mean temperature of the year is at least 25°. In the equinoctial region of Mexico and New Grenada, the *cerealia* yield abundantly, only at 42° and 46° latitude, a height at which its cultivation ceases in Europe * ; at Venezuela and in the Island of Cuba, on the con-

from the government of Venezuela, which, according to him, comprehends only the province of Caraccas. The *Republic of Venezuela*, founded July 5th, 1811, and restored August 16th, 1813, was united to the Republic of Cundinamarca (Dec. 17th, 1819), by the name of Columbia, and since that union the name of Venezuela has been again officially restrained (Feb. 1822) to a *department* comprehending the provinces of Caraccas and Varinas. Amidst these fluctuations there is a risk of confounding a country twice as large as Spain, with another less than the state of Virginia, if the precise sense in which the word Venezuela is employed, be not determined. Regarding this name as identical with that of *Capitania-general of Caraccas*, we obtain a collective designation for the whole eastern part of Columbia, and we may say *Venezuela*, as we do Mexico, Chili, or Peru.

* At 900 and 1100 toises elevation, the fields of wheat and rye disappear in the maritime Alps and in Provence. See the

trary, the *lower limit* of wheat descends, in the most unexpected manner, towards the burning plains of the coast. Hitherto the production of the *cerealia* at Venezuela has been of small importance; it does not amount at Barquesimeto and Victoria to more than 12,000 quintals a year; and as the same places, being but little elevated, are also fit for the culture of the sugar-cane, of coffee, and cotton, that of wheat has not been able to obtain any considerable increase.

It is not the province of Caraccas alone that, in Venezuela, contains *regions of temperate climates*; that is, countries where the centigrade thermometer falls at night below 16° or 14°, and even to 12·5°. The province of Cumuna has also its mountainous districts, which, though little visited hitherto, may yet become important for some new branches of equinoctial agriculture. Having passed through a great part of Venezuela with the barometer in my hand, I think it proper to state here succinctly the countries that merit the name of *tierras templadas* *, many of which, well-fitted for the production of *cerealia*, are too cold for the culture of coffee. This enumeration having merely an agricultural view, we shall mark only the high vallies or table-lands of a considerable extent. The Paramo of Mucuchies, which belongs to the *Sierra nevada* of Merida, the Silla of Caraccas, in the Cordilleras of the shore, and the Duida, in the missions of the Upper Oroonoko, are 2100, 1340, and 1280 toises high, but

researches on the temperature required for cultivated plants, in my work on *Distributions geog. plant.* 1817, p. 161.

* I should here mention that in adopting the somewhat vague denominations of *tierras, calientes, templadas, and frias*, I fix the first between the coast and the elevation of 300 toises; the second, between 300 and 1100 toises; and the third, between 1100 and 2460 toises. The last number, that of the limit of perpetual snows, indicates, in the equinoctial region, the cessation of vegetable life.

there are scarcely any spots on the declivities of these mountains capable of being cultivated. The same is the case with respect to the range of lofty secondary mountains of limestone, of mica-slate, and gneis-granite, that extend along the coast of Venezuela, from Cape Paria towards the lake of Maracaybo. This chain of the coast has not a sufficient mass to furnish those extensive table-lands which in Quito and Mexico unite the whole cultivation of Europe. The *lands with temperate climates*, (consequently above 300 toises,) of the ancient *Capitania-general* of Caraccas, are 1st. the mountainous part of the missions Chaymas * in New Andalusia ; that is, the Cerro del Impossible (297 toises), the savannahs of Cocollar and Tumiriquiri (400-700), the vallies of Caripe (412 toises), and of la Guardia de San Augustin (533 toises) : 2d. the declivities (*faldas*) of Bergantin †, between Cumana and Barcelona, the height of which is not exactly known, but appears to exceed 800 toises : 3d. the small table-land of Venta-grande, between La Guayra and Caraccas (755 toises) : 4th. the valley of Caraccas ‡, (460 toises) : 5th. the mountainous and arid country between Antimano and the Hacienda del Tuy, or the Higuerote and Las Cocuyzas §, are nearly 850 toises high ; 6th. the granite table lands|| of Yusma, (320 toises) Guacimo, Guiripia, Ocumare, and Panaquire, between the Llanos and the southern range of the mountains on the shore of Venezuela ; 7th. the dividing ridge between the tributary streams of the Caribbean Sea and the Apure, or the groupe of table-lands and hills 350 to 500 toises high, which connect the chain ¶ of the shore with the Sierra de Merida and

* Vol. iii. p. 69, 86—119, 162, 163.

† Vol. ii. p. 204, 205 ; Vol. iii. p. 94, 95.

‡ Vol. iii. p. 394, 447.

§ Vol. iv. p. 79, 80.

|| Vol. iv. p. 269.

¶ Vol. iv. p. 248.

the Truxillo; namely, Montana de Santa María, west of Torito, el Picacho de Nirgua, el Altar, and the vicinity of Quibor, Barquesimeto, and Tocuyo : 8th. the table-land of Truxillo (above 420 toises); and the *tierras frias* of Paramos de las Rosas, Boconò and Niquitao, between the sources of the Rio Motatan, and those of the Portuguesa and the Guanare : 9th. the whole mountainous land that surrounds the *Sierra nevada* of Merida, between Pedraza, Lavellaca, Santo Domingo, Macuchies, the Paramo de los Conejos, Bayladores, and La Grita (700-1600 toises) : 10th. some spots, perhaps of the Cordillera de Parime, which separates the basin of the Lower Oroonoko from that of the Amazon ; the groupe of the granitic mountains of Sipapo and the Sierra Maraguaca*.

Not having visited with Mr. Bonpland the cold region of the province of Varinas, the declivity of the Sierra Nevada of Merida, and the *Paramos* at the north of Truxillo, which, according to the analogy of the observations I made in the Andes of Pasto and Quito, must be 1700 and 2100 toises high, I cannot judge of the extent of the vallies and tablelands which the western regions of Venezuela may one day furnish for the culture of the *cerealia* of Europe. It is not, as we have observed above, the knowledge of the absolute height of the peaks which can enlighten us respecting the problems of agriculture. Where the spots lying beneath the benign influence of a temperate or cold climate are on declivities too steep to be easily ploughed, the price of native flour would be too high to be brought into competition with the flour of the United States, of Mexico, and Cundinamarca. As in our Mediterranean, Italy and Greece have long drawn their corn from the opposite coast of Mauritania and Egypt, so also in the Mediterranean of America, Venezuela and the shore of New Grenada now receive their supply of flour from the opposite coast of the United States†. Don Manuel Torres,

* Vol. v. p. 554, 555, 605, 606.

† Itinerary manuscripts of M. Palacio Faxardo.

in an official letter addressed to the Secretary of State at Washington, estimates the exportation of North American flour for Columbia at 20,000 barrels a year. (*Message from the President of the United States*, 1822, p. 48. See also above, Vol. iv, p. 104, 105, and 111, 112.) In a state of free trade, the immense progress of the art of navigation exposes the native cultivation to a dangerous rivalry with that of the most distant countries. The fields of the Crimea supply the markets of Leghorn and Marseilles; the United States furnish Europe with corn, and in times of scarcity the table-land of Mexico sends its produce to Spain, Portugal, and England. Regions, some of which scarcely produce the 6th or 7th, and others the 20th or 25th grain, are placed in competition with each other, and the problem of the utility of a production is complicated by the variable effects of the fertility of the soil, and the price of labour. The western part of Columbia (New Grenada), will always possess great advantages with respect to the production of the cerealia, by the magnitude of its mountains, and the extent of its table-lands, over the eastern part of Columbia (Venezuela); it thence results that the rivalry of the flour of Socorro and of Bogota, which goes down by the Meta, will be to be divided by the regions north of the Oroonoko. Where temperate regions are in the vicinity of hot, between 300 and 500 toises high (as in the temperate spots of the provinces of Cumana and Caraccas), the cultivation of sugar, of coffee, and of the cerealia is equally practicable, and experience proves, pretty generally, that the cultivation of the two former is preferred as being the most lucrative.

Quinquina. The Cuspar, or *Cortex Angosturæ*, falsely called the quinquina of the Oroonoko, has become famous by the industry of the Catalan-Capucin monks. It is not a Rubiacée like the Cinchona, but a plant of the family of Diosmés, or Rutacés. This precious plant has hitherto been exported only from the Spanish Guyana, though it is also

found in Cayenne. (Vol. v. 767.) We are yet ignorant to what genus the Cuspa, or *quinquina* of *Cumana* belongs, but its properties being eminently febrifuge, it may become an important object of trade. (Vol. iii. p. 27.) Five species of real quinquina (*Cinchonæ*, *corollis hirsutis*), so common in New Grenada, have been discovered in the western part of Venezuela. The febrifuge-bark of the quinquina (*buenas quinas*, or *cascarillas*) is gathered on both the declivities of the *Sierra Nevada* of Merida, on the road from Varinas-viejas to Paramo de Mucuchies, called the road of Los Callejones, a little above the ravine of Lavellaca; and also between Viscucuy and the town of Merida *. These are all the real quinquinas (*Cinchonæ*) that have hitherto been found principally on the coast of Spanish America. No species of *Cinchona* is yet known, not even of the kindred genus, *Exostema*, either in the mountains of the Silla de Caraccas, where the Befaria, Aralia, Thibaudia, and other alpine shrubs of the Cordilleras of New Grenada vegetate, nor in the mountains of Tumiriquiri and Caripe, and French Guyana †. This total absence of the *Cinchona* and *Exostema* on the tableland of Mexico, and in the oriental regions of South America, north of the equator, (if it be as absolute as it has hitherto appeared,) is the more surprising as the West Indies are not destitute of quinquina with smooth corolla and projecting stamina. In the southern hemisphere, the temperate parts of Brazil also, have yet only furnished the botanic traveller with one species of real *Cinchona*, a kind separated in a

* See above, Vol. iii, p. 29, 30; Vol. iv, p. 248; Vol. v. p. 767. Lambert, *Illustration of the genus Cinchona*, 1821, p. 57. The pretended *Cinchona Brasiliensis* of the herbal of Willdenow, with a calice of the length of the corolla, and vegetating in the hot regions of Grand Para, is perhaps only a *Machaonia*.

† See the note G at the end of the 9th book.

striking manner by its fruit from the *Macrocnemums*. According to the fine discovery of M. Auguste de St.-Hilaire, the *Cinchona ferruginea* is found in the temperate regions of the *Capitania* of Minas Geraes, where it is employed under the denomination of *quina de serra*.

In concluding this sketch of the vegetable productions of Venezuela, that may one day become objects of traffic, I shall name succinctly the *Quassia Simaruba* of the valley of Rio Caura; the *Unona febrifuga* of Maypures, known by the name of *Frutto de Burra*; the *Zarza* or sarsaparilla of the Rio Negro; the oil of the cocoa-tree, which may be considered as the olive-tree of the province of Cumana; the oily almonds of *Juvia* (*Bertholletia*); the resins and precious gums of the Upper Oroonoko (*Mani, Carana*); the caoutchouc similar to that of Cayenne*, or subterranean (*dapiche*); the aromatics of Guyana, such as the *Tonga bean* or fruit of *Coumarouma*; the *Pucheri* (*Laurus Pichurim*); the *Varinacu*, or false cinnamon (*L. Cinnamamoides*); the vanilla of *Turiamo*, and the great cataracts of the Oroonoko; the fine colouring substances which the Indians reduce to a paste, (*Chica* or *Puruma*); the *brésillet*; Dragon's blood; *l'aceyte de Mariu*; the nourishing raquelles (*Clactus*), the cochineal of Carora: the precious wood for the cabinet-maker, such as mahogany (*cahoba*), the cedrela odorata (*cedro*), the *Sickinia Erxthroxylon* (red *Aguatire*) &c.; the noble timber of the family of the *Laurinia*, and the *Amyris*; and the cordage of the palm-tree *Chiquichiqui*, so remarkable for its lightness. (See above, Vol. iii. pp. 74, 200, 278; Vol. iv. pp. 78, 246, 255, 513, 553; Vol. v. pp. 162, 257, 284, 374, 378, 536, 544.

We have stated above in what manner, by a peculiar disposition of the lands, the three zones of agricultural, pastoral, and hunting-life, suc-

* Vol. iii. p. 423.

ceed each other in Venezuela from the north to the south along the coast towards the equator. Advancing in this direction, we may be said to traverse, in point of space, the different stations by which the human race has passed in the lapse of ages, in its progress towards cultivation, and in laying the foundations of civil society. The region of the shore is the centre of agricultural industry; the region of the Llanos serves only for the pasturage of the animals which Europe has given to America, and which live there in a half-savage state. Each of those regions contains from seven to eight thousand square leagues; further south, between the delta of the Oroonoko, the Cassiquiare, and the Rio Negro, lies a vast extent of land as large as France, inhabited by hunting nations, *horrida sylvis, paludibus fæda*. The productions of the vegetable kingdom which we have just enumerated belong to the zones at each extremity; the intermediary savannahs into which oxen, horses, and mules have been brought, since the year 1548, feed some millions of those animals. At the period of my travels, the annual exportation of Venezuela to the West India islands amounted to 30,000 mules, 174,000 ox hides, and 140,000 *arrobes* (of 25 pounds) of *tasajo* * or dried meat a little

* The meat on the back is cut in slices of moderate thickness. An ox or cow, of the weight of 25 arrobes, produces

salted. It is not from the advancement of agriculture, or the progressive encroachments on the pastoral lands, that the *hâtes* have diminished so considerably within twenty years, but rather from the disorders of every kind that have prevailed, and the want of security for property. The impunity extended to the skin-stealers, and the accumulation of vagabonds in the savannahs, preceded that destruction of the cattle which the successive wants of armies, and the inevitable ravages of civil war have so deplorably increased. A very considerable number of goat-skins is exported to the Island of Marguerite, Punta Araya, and Corolas; sheep abound only in Carora and Tocuyo*. The consumption of meat being immense in this country, the diminution of animals has a greater influence than in any other district on the well-being of the inhabitants. The town of Caraccas, of which the population in my time was one-tenth of that of Paris, consumed more than half the quan-

only 4 to 5 arrobes of *tasajo* or *tasso*. In 1792, the port of Barcelona alone, exported 98,017 arrobes to the Island of Cuba. The average price is 14 *realés de plata*, and varies from 10 to 18. (There are 8 realés in a piastre.) Mr. Urquinasa estimates the total exportation of Venezuela in 1809, at 200,000 arrobes of *tasajo*.

* See above, Vol. i, p. 237; Vol. iii. p. 361, 365; Vol. iv, p. 210, 338, 341, 383; Vol. v. p. 75, 715, 802, 803.

tity of beef annually used in the capital of France *.

I might add to the productions of the vegetable and animal kingdoms of Venezuela the enumeration of the minerals, the working of which is worthy the attention of the government; but having been devoted from my youth to the practical labours of mines, which had been placed under my management, I know

* The following table proves how great is the consumption of meat in the towns of South America, near the Llanos :—

| <i>Towns.</i> | <i>Years.</i> | <i>Population.</i> | <i>Oxen.</i> |
|-----------------------------|---------------|--------------------|--------------|
| Caraccas | 1799 | 45,000 | 40,000 |
| Nueva Barcelona..... | 1800 | 16,000 | 11,000 |
| Portocabello | 1800 | 9,000 | 7,500 |
| (Paris | 1819 | 714,000 | 70,800) |

The consumption at Mexico, of which the population is four or five times less than that of Paris, does not exceed 16,300 oxen; consequently it does not appear much greater than at Paris; but we must not forget, 1st, that Mexico is situated on a table-land cultivated with corn, and far from pasturage; 2d, that this town reckons nearly one-fourth of copper-coloured Indians among its inhabitants, who eat little meat; and 3d, that the consumption of sheep is 273,000, and of hogs at Mexico is 30,000; while at Paris, notwithstanding the enormous difference of population, it was in 1819 only 329,000 of the former, and 65,000 of the latter. See above, Vol. iii, p. 464, 465; Vol. vi. p. 76, and my *Political Essay on New Spain*, Vol. ii, p. 68†. *Recherches stat. sur la ville de Paris, par le comte de Chabrol, 1823, tableau 72.*

† According to the statement given in this Work by the Author, the consumption of sheep at Mexico was 278,923, and of hogs, 50,676.—*Trans.*

how vague and uncertain are the judgments we form of the metallic wealth of a country from the mere appearance of the rocks, and of the veins in their beds. The utility of such labours can be determined only by well directed attempts by means of shafts or galleries. All that has been done in researches of this kind, under the dominion of the mother country, has left the question wholly undecided, and the most exaggerated ideas have been recently spread through Europe, with very culpable levity, concerning the riches of the mines of Caraccas. The common denomination of Columbia given to Venezuela and New Grenada, has, no doubt, contributed to facilitate those illusions. It cannot be doubted that the gold-washings of New Grenada furnished, in the last years of public tranquillity, more than 18,000 marks of gold; that Choco and Barbacoas furnish platina in abundance; the valley of Santa Rosa, in the province of Antioquia, the Andes of Quindiu and Gauzum, near Cuença, sulphurated mercury; the table-land of Bogota (near Zipaquira and Canoas), fossile-salt and pit coals; but even in New Grenada, real subterranean labors, on the silver and gold veins, have hitherto been very rare *. I am far, however, from wishing to discourage the miners of those countries; I merely conceive that it is not necessary, in order to

* *Political Essay on New Spain*, Vol. iii, p. 299 and 379.

prove to the old world the political importance of Venezuela, the amazing territorial wealth of which is founded on agriculture and the produce of pastoral life, to describe as realities, or as the conquests of industry, what is, as yet, founded solely on hopes, and probabilities more or less uncertain. The republic of Columbia possesses also on its coast, on the Island of Marguerita, on the Rio Hacha, and in the gulf of Panama, pearl fisheries of ancient celebrity. In the present state of things, however, these pearls are as insignificant an object as the exportation of the metals of Venezuela. The existence of metallic veins on several points of the coast cannot be doubted. Mines of gold and silver were worked, at the beginning of the conquest, at Buria, near Barquesimeto, in the province of Los Mariches, Baruta, on the south of Caraccas, and at Real de Santa Barbara, near the Villa de Cura. Grains of gold are found in the whole mountainous territory between Rio Yaracuy, the Villa de San Felipe and Nirgua, as well as between Guigue and los Moros de San Juan. Mr. Bonpland and myself, during our long journey, saw nothing in the gneis-granite of Spanish Guyana to confirm the ancient belief of the metallic wealth of that district ; yet it seems certain, from several historical indications, that there exist two groupes of auriferous alluvial land ; one, between the sources of

the Rio Negro, the Uaupes and the Iquiare; the other, between the sources of the Essequibo, the Caroni, and the Rupunuri. I flatter myself that if the government of Venezuela should ever make a thorough examination of the principal metallic beds of its soil, the persons to whom those researches are confided, will find in the 13th, 16th, 17th, 24th, and 27th chapters of this work, geognostic notions which may be useful to them, because they are founded on a detailed knowledge of the localities *. Hitherto only one working is found in Venezuela, that of Aroa; it furnished, in 1800, near 1500 quintals of copper of an excellent quality. The greenstone rocks of the passage mountains of Tucutunemo (between Villa de Cura and Parapara) contain veins of malachite and copper pyrites. The indications of both ochreous and magnetic iron in the coast chain, the native alum of Chuparipari, the salt of Araya, the kaolin of Silla, the jade of the Upper Oroonoko, the petroleum of Buen-Pastor, and the sulphur of the eastern part of New Andalusia, equally merit the attention of the administration †.

It is easy to ascertain the existence of some mineral substances, which afford hopes of a lu-

* Vol. iii, p. 524—535; Vol. iv, 252, 269, 274, 470; Vol. v, 311, 342, 401, 507, 559, 809, 826, 852, 863.

† Vol. ii, p. 254—272; Vol. iii, p. 103—108, 204. Vol. iv, p. 51; and in the present volume, p. 103.

crative working, but it requires great circumspection to decide whether the abundance of mineral and the facility of reaching it, be sufficiently great to cover the expence*. Even in the eastern part of South America, gold and silver are found dispersed in a manner that surprises the European geognost; but that dispersion, the divided and entangled state of the veins, and the appearance of some metals only in masses, render the working extremely expensive. The example of Mexico proves sufficiently that the interest attached to the labours of the mines is not hurtful to agricultural pursuits, and that those two kinds of industry may simultaneously promote each other. The inutility of the attempts made under the intendance of Don Jose Avalo must be attributed solely to the ignorance of the persons employed by the Spa-

* In 1800, a day-labourer (*peon*) employed in working the ground, gained, in the province of Caraccas, 15 sols, exclusive of his food. (Vol. iv, p. 128.) A man who hewed building timber in the forests on the coast of Paria, was payed at Cumuna, 45 to 50 sols a day, without his food. A carpenter gained daily from 3 to 6 francs, in New Andalusia. Three cakes of Cassara (the bread of the country), 21 inches in diameter, $1\frac{1}{2}$ line thick, and $2\frac{1}{8}$ lb. weight, cost at Caraccas, a half-*real de plata* or $6\frac{1}{2}$ sols. A man eats daily not less than 2 sols worth of cassara, that food being constantly mixed with bananas, dried meat (*tassajo*), and *papelon*, or unrefined sugar. Compare for the price of provisions, Vol. iv, p. 242, 388; Vol. v, 152.

nish government, and who gravely took mica and amphibol for metallic substances. If the government have the perseverance to cause the ancient *Capitania-general* of Caraccas to be examined during a long series of years, and is so fortunate as to choose men as distinguished as MM. Boussingault and Rivero, who are establishing at present a school of mines at Bogota, and who join to a solid knowledge in geognosy and chemistry, the practical habit of mining, the most satisfactory results may be expected.

COMMERCE AND PUBLIC REVENUE.—The description we have given above * of the productions of Venezuela, and the development of its coast, is sufficient to show the importance of the commerce of that rich country. Even amidst the shackles of the colonial system, the value of the exports of the products of agriculture, and of the gold-washings, amount to 11 or 12 millions of piastres, in the countries which are at present united under the denomination of the Republic of Columbia. The exports of the *Capitania general* of Caraccas alone, apart from the precious metals, which are the object of a regular working, was (with the contraband), from 5 to 6 millions of piastres, at the beginning of the 19th century. Cumana, Barcelona, La Guayra, Portocabello, and Mara-

* See above, pp. 181 and 200.

caybo, are the most important parts of the coast ; those that lie most to the eastward have the advantage of an easier communication with the Virgin Islands, Gaudeloupe, Martinique, and St. Vincent. Angostura, the real name of which is Santo Tomè of Nueva Guyana, may be considered as the port of the rich province of Varinas. The majestic river, on the banks of which this town is built, furnishes, by its communications with the Apure, the Meta, and the Rio Negro, the greatest advantages for trade with Europe *.

In order to form a correct idea of the importance of Venezuela, with respect to its exports and imports of the productions of the old world, we must recur to a period of external peace, which preceded the revolution of Spanish America twelve or fifteen years. The trade of La Guayra was then in its greatest splendour. The following are the official results of the registers of the custom house, which throw some light on the commercial state of those regions, and which were not published by MM. Depons and Dauxion-Lavaysse, in their voyages to *Terra Firma*, and the *Isle of Trinity*.

I. TRADE OF LA GUAYRA, in 1789.

| | |
|--------------------------------|--------------------|
| Imports, value | 1,525,905 piastres |
| Of which the duties paid | 160,504 |
| Exports, value | 2,232,013 |
| Of which the duties paid | 167,458 |

A. Imports :

| | |
|---------------------|------------------|
| Spanish Goods | 777,555 piastres |
| Foreign | 748,350 |

* See Vol. iv, p. 564 ; Vol. v, p. 512, 607, 686, 715.

B. Exports :

Gold and silver coin..... 103,177 piastres

Produce 2,128,836

Among which ;

Cotton 170,427 pounds

Indigo..... 718,393

Tobacco 202,152

Cacao 103,855 fanegas

Coffee..... 23,371 pounds

Hides 12,347 pieces

Buckskins..... 2,905

Marroquins..... 1,388

II. TRADE OF LA GUAYRA, in 1792.

Imports, value 3,582,311 piastres

Exports 2,315,692

A. Imports :

From the ports of America 60,348 piastres

From Spain..... 1,855,278

From other parts of Europe .. 1,666,685

B. Exports :

| | INDIGO, Pounds. | COTTON, Pounds. | CACAO, Fanegas. | COFFEE, Pounds. | HIDES, Pieces. |
|-------------------------------|--------------------|--------------------|--------------------|--------------------|-------------------|
| For Spain - - | 669,827 | 225,503 | 100,592 | 138,968 | 15,332 |
| For Foreign Co- lonies - - | 10,402 | 33,000 | .... | 9,932 | 70,896 |
| | 680,229 | 258,503 | 100,592 | 148,900 | 86,228 |

III. TRADE OF LA GUAYRA, in 1794.

A. Exports :

| | INDIGO, Pounds. | COTTON, Pounds. | CACAO, Fanegas. | COFFEE, Pounds. | HIDES, Pieces. |
|-------------------------------|--------------------|--------------------|--------------------|--------------------|-------------------|
| For Spain - - | 875,907 | 431,658 | 111,133 | 307,032 | 5,305 |
| For Foreign Co- lonies - - | 22,446 | .... | .... | 57,606 | 49,308 |
| | 898,353 | 431,658 | 111,133 | 364,638 | 54,613 |

B. Imports :

| | |
|--------------------------------------|--------------------|
| <i>a</i> Merchandize and Provisions. | |
| Spanish | 1,111,709 piastres |
| Foreign from Europe | 868,812 |
| — the United States | 75,993 |
| — the West Indies | 13,415 |
| | <u>2,069,929</u> |
| <i>b</i> Silver coin | 60,000 |
| | <u>2,129,929</u> |
| Total imports | 2,129,929 |

IV. TRADE OF LA GUAYRA, in 1796.

A. Exports, value..... 2,403,254 piastres.

Namely :—

| | INDIGO, Pounds. | COTTON, Pounds. | CACAO, Fanegas. | COFFEE, Pounds. | TOBACCO Pounds. | HIDES, Pieces | COPPER, Pounds. |
|-------------------------------------|--------------------|--------------------|--------------------|--------------------|--------------------|------------------|--------------------|
| For Spain - - - | 709,135 | 483,250 | 70,280 | 482,000 | 454,723 | 1,531 | 31,142 |
| For the United States - - - | 132 | .... | 5,258 | 162 | .... | .... | .... |
| For the Foreign W. India Islands | 28,699 | 53,928 | .... | 2,500 | .... | 79,777 | .... |
| | <u>737,966</u> | <u>537,178</u> | <u>75,538</u> | <u>484,662</u> | <u>454,723</u> | <u>81,308</u> | <u>31,142</u> |

B. Imports :

| | | |
|--|--|--------------------|
| <i>a</i> From Spain, in national products | | 1,871,571 piastres |
| Foreign | | 1,429,487 |
| <i>b</i> From Foreign American Colo- nies | | <u>179,002</u> |
| Total importation | | 3,480,060 |

Import and Export Duties, paid
at the custom-house, amounted
to..... 587,317 piastres

V. TRADE OF LA GUAYRA, in 1797.

A. Exports, value 1,113,695 piastres

Namely :—

| | INDIGO, Pounds. | COTTON, Pounds. | CACAO, Fanegas. | COFFEE, Pounds. | TOBACCO Pounds. | SUGAR, Cases. | HIDES, Pieces. | COPPER, Pounds. |
|----------------------------------|--------------------|--------------------|--------------------|--------------------|--------------------|------------------|-------------------|--------------------|
| For Spain - | 61,785 | 50,285 | 46,075 | 153,699 | .... | .... | 671 | 2,000 |
| For the United States - - | 2,256 | .... | 4,024 | .... | .... | 738 | .... | .... |
| For the Foreign W. I. Islands | 56,894 | 57,711 | 20,733 | 155,813 | 175,719 | 638 | 286 | 400 |
| | 120,935 | 107,996 | 70,832 | 309,512 | 175,719 | 1,376 | 957 | 2,400 |

A. Imports, value :—

a From Spain 98,388 piastres

b Foreign :

From the United States 76,568

— the West Indies 389,844

Total imports 564,800 piastres

Export and Import Duties, paid at the

Custom House 242,160 piastres

In comparing these statements, which are taken from the registers of the custom-house at La Guayra, with those of the ports of Spain in my possession (Vol. iv, p. 240), we see that according to the declarations of the vessels, less cacao has entered Spain from Caraccas than from La Guayra. The diminution of the imports and exports in 1797, indicate no decline of national industry ; it is the consequence of the renewal of maritime war, Spain having till then, since its peace with the French republic, enjoyed a happy neutrality. The registers of the Custom-house, which I have just stated, during four years, 1789, 1792, 1794, and 1796, give, for the average of the imports of La Guayra, which is the principal port of Venezuela, 2,678,000 piastres ; and for the average of the exports, 2,317,000 piastres. If we fix on the years

1793—1796 only, we have for the exports 3,060,000 piastres, while the years of war, comprehended between 1796 and 1800, furnish an average of only 1,610,000 piastres. (*Depons*, Vol. ii, p. 439.) In the year 1809, and consequently only a short time before the revolution of Caraccas *, the balance of trade at La Guayra ought to have been little different from what it was in 1796. I discovered in a journal of Santa Fe de Bogota (*Semanario*, Vol. ii, p. 324), an official extract of the registers of the custom-house, for the first six months of

* The following are the principal epochas of that revolution. The *supreme Junta* of Venezuela, who declared they would maintain the rights of Ferdinand VII, and who banished the captain-general and the members of the *Audiencia*, assembled 19th April, 1810. The *congress* which succeeded the supreme Junta, 2d March, 1811, declared the independance of Venezuela, 5th July, 1811. The congress held its sittings at Valencia, in the vallies of Aragua, in March, 1812. The earthquake that destroyed the greater part of the town of Caraccas, on the 26th March, 1812 (Vol. iv, p. 12), rendered the Spaniards again masters of the country in August, 1812. General Simon Bolivar retook Caraccas, and entered it in triumph, August 16th, 1813. The royalists became masters of Venezuela in July, 1814, and of Bogota, in June, 1816. In the same year, General Bolivar disembarked at the island of Marguerita, at Carupano, and at Ocumare. The second congress of Venezuela was installed at Angostura, February 15th, 1819. The *fundamental law* that unites Venezuela to New Grenada, by the name of the republic of Columbia, was proclaimed December 17th, 1819. The armistice, concluded between the Generals Bolivar and Morillo, is dated November 25th, 1820. The constitution of the Republic of Columbia dates August 30th, 1821. The government of the United States recognized that Republic, March 8th, 1822.

the year ; during that period the imports from Spain were 274,205 piastres ; from foreign parts, 768,705 piastres ; total value of the imports, 1,042,910 piastres. The exports for Spain were 778,802 piastres ; for foreign parts, 623,805 ; total value of the exports, 1,402,607 piastres. We may consequently regard 2,700,000 piastres as the mean term of the exports of the port of La Guayra at the beginning of the 19th century, in a year when the country enjoyed internal and external tranquillity*.

The ports of Cumana and Nueva Barcelona, at the period of the revolution, exported annually, (comprehending the produce of the illicit trade,) to the value of 1,200,000 piastres ; in which were comprised 22,000 quintals of cacao, a million of pounds of cotton, and 24,000 quintals of salt meat. If we add to the exports of La Guayra, Cumana, and Nueva Barcelona, a million of piastres, as the produce of the trade of Angostura and Maracaybo, and 800,000 piastres as the value of the mules and oxen embarked at Portocabello, Carupano, and other small ports of the Atlantic, we shall find the total value of the produce exported in the an-

* I communicated many details respecting the merchandise registered in the custom houses of Spain, for the ports of *Terra Firma*, in 1795, to M. Dauxion-Lavaysse, which he inserted in his *Voyage à la Trinité*, Tom. ii, p. 464. I drew my information from a very instructive memoir of the Count de Casa Valencia, on the means of vivifying the trade of Caraccas. M. Urquinaona (*Relac. docum.*, p. 13), estimates the total of the exports of Venezuela, in 1809, at eight millions of piastres.

cient *Capitania-general* of Caraccas, to be more than six millions of piastres. It is very probable that the consumption of the provisions of Europe and of other parts of America reached nearly the same amount in the peaceful times which immediately preceded the revolution. As nothing is more vague than the pretended balances of trade founded on the custom house registers, and as we are ignorant whether the contraband trade with the West India Islands augments the value of registered articles, a quarter, a third, or a half, it is not uninteresting to verify the results we have just obtained by the partial estimate of the wants of the population. Now it is found, by minute calculations made on the spot, that the consumption of foreign productions* in the *Gobierno* of Cumana, was, for each adult individual of the richest class, inhabiting towns, but 102 piastres yearly; for an adult slave, 8 piastres; for children, not indians, less than 12 years of age, $\frac{3}{4}$ piastre; for every adult indian, in the most civilized communes (*de doctrina*), 10 piastres; for a family of indians, composed of four persons entirely naked, such as they are found in the missions of

* *Informe de Don Manuel Navarete, Tesorero de la Real Hacienda en Cumana sobre el estanca de tabaco y los medios de su abolicion total* (Manuscript). In this reasoning on the consumption, the words *foreign articles* indicate all merchandize which is not originally of Venezuela.

Chaymas, 7 piastres. According to these statements, and supposing that in the two provinces of Cumana and Barcelona, there are only 86,000 inhabitants, of whom 42,000 are Indians; and adding the necessary annual expences for the embellishment and service of the churches, for the support of the religious communities, and the equipment of vessels, M. Navarete estimates the value of goods drawn from foreign parts at 853,000 piastres, which makes nearly 10 piastres for each individual, of every age and caste. It cannot be doubted that during the period of civil troubles, and by a more frequent contact with the nations of Europe, luxury has been prodigiously augmented in the populous towns of Venezuela; but the population of towns is in Spanish America but an inconsiderable fraction of the general population; and with the habits of sobriety maintained by the great mass who inhabit the country distant from the coast, I conceive that the 785,000 inhabitants, which we now attribute to Venezuela, will require, when the country shall enjoy perfect tranquillity, foreign productions to the value of more than seven millions of piastres.

I entreat such of my readers as love to employ themselves on financial considerations, to attend for a moment to these numerical results. Europe, overloaded with manufactures, seeks channels for the dispersion of the production of

her industry. Such is the state of dawning society in South America, that the population of Venezuela, which at most equals the mean population of two departments of France *, stands in need annually, for its interior consumption, of merchandize and foreign articles to the amount of 35 millions of francs. More than four-fifths of those articles come by different ways, from the markets of Europe. Yet, the population of Venezuela is poor, frugal, and little advanced in civilization. If, according to the statements of imports, it appears to have a great consumption, and feeds the industry of commercial nations by its wants, this arises from its being entirely destitute of manufactures, and that the most simple mechanical arts have scarcely begun to be practised there. The maroquins and curried hides of Carora, the hammocks of the Island of Marguerita, and the blankets of Tocuyo, are objects of very small importance even for the inland trade. All the fine tissues and coloured linens used at Venezuela come from foreign ports. When the commerce of France with the American colonies was most flourishing, before the year 1789, she exported to them to the amount of 80 millions of francs, in the productions of the French soil and industry. This amount is little more than that of the total value of the foreign consump-

* See above, p. 187, note *.

tion of Columbia. I dwell on the importance of these considerations, to prove how much the nations of the old world are interested in the prosperity of the free states that are forming in equinoctial America. If those states, whilst harassed from without, continue to remain agitated, a civilization which has not taken deep root will be gradually destroyed ; and the whole of Europe, without advantage to the mother country, which could neither tranquillize its colonies, nor permanently re-possess them, will be deprived, for a long period of time, of a market fitted to give life to trade and manufacturing industry.

I shall add to these considerations some statistical statements little known, taken from a very recent memoir of the *Consulado de la Vera Cruz*. This document shews that Venezuela by its entire want of manufactures, and the small number of its indian inhabitants, presents in proportion to the respective population, a greater consumption of foreign articles than New Spain. In a period of twenty-five years, from 1796 to 1820, the importation * from the

* In the commercial register published at Vera-Cruz, the imports and exports made on account of the government are not included. For instance, in the year 1802, the extent of trade (the same of the exports and imports), is indicated at 60,445,955 piastres. If to this had been added the amount of $19\frac{1}{2}$ millions of piastres embarked on the king's account,

port of Vera-Cruz, according to the registers of the custom-house, amounted to 259,105,940 piastres, of which 186,125,113 piastres were from the mother country. The consumption of New Spain in European articles, during the same period, was 224,447,132 piastres, or 8,977,885 piastres annually. We are struck with the smallness of this sum, compared with the wants of a population of 6 millions of souls; and therefore the secretary of the *Consulado de la Vera Cruz*, M. Quiros, concludes that the contraband exportation rose, taking one year with another, to more than 12 or 15 millions of piastres. According to these calculations, made by persons who have a perfect knowledge of the localities, Mexico must consume at the utmost, in its present state, foreign articles of the value of 21 to 24 millions of piastres, that is, with a population eight times greater, not four times as much as the ancient *Capitania-general* of Caraccas. So great a difference between two markets open to the trade of Europe, on the coasts of Mexico and Venezuela, will, I believe, appear less extraordinary, if we recollect that among the 6,800,000 inhabitants of New Spain, there are more than 3,700,000 indians of an un-

and the value of mercury and paper for cigars, received on account of the *Real Hacienda*, the extent of trade, in 1802, would have been 82,077,000 piastres; and in 1803, it would have been 43,897,000 piastres instead of 37,379,637.

mixed race *, and that the manufacturing industry of that fine country is already so much advanced that the value of its home fabrics in wool and cotton, in 1821, amounted to 10 millions of piastres per annum †. In deducting the indian population, whose wants are almost entirely restricted to the productions of the soil, from the total population of Venezuela and Mexico, we find in the former country, that the consumption of the productions of foreign industry, amount to 10 piastres, and in the latter, to 8 piastres for every individual of all ages and both sexes. These results shew, that when we consider the great masses only, the state of society appears nearly the same in the most distant parts of Spanish America, notwithstanding the varying influence of physical and moral causes.

The shores of Venezuela from the beauty of their ports ‡, the tranquillity of the sea by which

* (See my *Political Essay on New Spain*, Vol. iv, p. 127). During the 25 years that preceded the year 1820, gold and silver were coined at Mexico to the value of 429,110,008 piastres. See above. p. 129.

† *Balanza del Comercio reciproco hecho por el puerto de Vera Cruz coo los de España y de America en los ultimos 25 años. (De orden del Consulado de Vera Cruz, el 18 de Abril 1821.)*

‡ The following is the series of anchorage, roads, and ports with which I am acquainted, from Cape Paria as far as Rio del Hacha ; Ensenada de Mexillones ; the mouth of the Rio Caribes ; Carupano ; Cumana (See above, Vol. ii, page

they are washed, and the fine ship timber that covers them, possess great advantages over the shores of the United States. In no part of the world is there found firmer anchorage, or fitter positions for the establishment of military posts. The sea of this coast is constantly calm, like that which extends from Lima to Guayaquil. The storms and hurricanes of the West Indies are never felt on the *Costa firme*; and when after the sun has passed the meridian, thick clouds loaded with electricity, accumulate on the mountains of the coast, this threatening aspect of the sky, denotes to a pilot accustomed to those latitudes, only a squall that scarcely obliges him to reef or take in the sails. The virgin-forests near the sea, in the eastern part of New Andalusia, present valuable resources for

211); Laguna Chica, on the south of Chuparuparu (Vol. vi, p. 97); *Laguna grande del Obispo* (Vol. iii, p. 21; Vol. vi, p. 108); Cariaco, (Vol. iii, p. 198); Ensenada de Santa-Fe; Puerto Escondido; *Port de Mochima* (Vol. iii, p. 358; Vol. vi, p. 108); Nueva Barcelona (Vol. iii, p. 361; Vol. vi, p. 77); the mouth of the Rio Unare; Higuerote (Vol. iii, p. 370; Chuspa; Guatire; *La Guayra* (Vol. iii, p. 382); Catia; Los Arcifes; Puerto la Cruz; Choroni; Sienega de Ocumare; Turiamo; *Burburata*; Patenebo (Vol. iii, p. 402); *Porto Cabello* (Vol. iv, p. 201); Chichiribiche (Vol. iv, p. 204); Puerto del Manzanillo; Coro; *Maracaybo*; Bahia Honda; El Portete et Puerto Viejo; the island of Marguerita has three good ports, Pampatar, Pueblo de la Mar, and Bahia de Juan Griego. (*Those printed in Italics are the ports most frequented.*)

the establishment of dock yards. The wood of the mountain of Paria may vie with that of the Isle of Cuba, Huasacualco, Guayaquil, and San Blas. The Spanish government had, at the end of the last century, fixed its attention on this important object. Marine engineers were sent to mark the finest trunks of Brazil-wood, mahogany, cedrela, and laurinea, between Angostura and the mouth of the Oroonoko, as well as on the banks of the gulf of Paria, vulgarly called *Golfo triste*. It was not intended to establish dock and yards on the spot, but to hew the weighty timber into the form necessary for ship building, and to transport it in the king's ships to Caraque, near Cadiz. Although trees proper for masts are not found in this country, it was yet hoped that the execution of this project would considerably diminish the importation of timber from Sweden and Norway. The establishment was attempted in a very unhealthy spot*, in the valley of Quebranta, near Guirie; I have already mentioned in another place, the causes of its destruction. The insalubrity of the place would, doubtless, have diminished in proportion as the forest (*el monte virgen*) would have been removed from the dwellings of the inhabitants. Mullattoes, and not whites, ought to have been employed in

* Vol. iii, p. 83.

hewing the wood, and it should have been remembered that the expence of the roads (*arastaderos*), for the transport of the timber, when once traced, would not have been the same, and that, by the increase of the population, the price of day labour would progressively have diminished. It belongs to ship-builders alone who know the localities, to judge, whether in the present state of things, the freight of merchant vessels be not far too dear to allow of sending large quantities of wood roughly hewn, to Europe; but it cannot be doubted that Venezuela possesses on its maritime coast, as well as on the banks of the Oroonoko, immense resources for ship building. The fine ships which have gone out of the yards of the Havanah, Guayaquil, and San Blas, have, no doubt, cost more than those constructed in Europe, but from the nature of tropical wood, they possess the advantage of hardness and amazing durability.

We have just analysed the objects of commercial industry at Venezuela and their immense value; it remains to take a view of the *means of commerce* which are found in a country destitute of high roads, and wheel carriages, and restricted to internal and external navigation. The uniformity of temperature that prevails in the greater part of these provinces, causes such an equality in the agricultural pro-

ductions necessary to life, that the want of exchanges is there felt less than at Peru, Quito, and New Grenada, where the most opposite climates prevail on a small space of land. The flour of the cereals is almost an object of luxury for the great mass of the population, and every province participating in the possession of the Llanos, that is of pasturages, draws its nourishment from its own soil. The inequality of the harvest of maize, varying according as rain is more or less frequent; the transportation of salt, and the prodigious consumption of meat in the most peopled districts, lead, no doubt, to exchanges between the Llanos and the coast; but the great and real object of commercial activity in the interior of Venezuela, is the carriage of products to be exported to the West Indies and to Europe; such as cacao, cotton, coffee, indigo, dried meat, and hides. It is singular, that, notwithstanding the great number of horses and mules that wander in the Llanos, no use is yet made of those great waggons which have for ages traversed the Pampas, between Cordova and Buenos-Ayres. I did not see one in a single waggon on Terra Firma; the conveyance of goods is all made on the back of mules, or by water. A road, however, might be easily traced, fitted for wheel carriages, from Caraccas to Valencia, in the vallies of Aragua, and thence by the Villa de Cura to the Llanos

of Calabozo, as well from Valencia to Portocabello, and from Caraccas to La Guayra. The *Consulados* of Mexico and Vera Cruz have known how to vanquish difficulties a hundred-fold greater, in constructing the fine roads from Perote to the coast, and from the capital to Toluca.

With respect to the internal navigation of Venezuela, it would be useless to repeat here what we have stated above, on the branchings and communications of the great rivers; we shall confine ourselves to direct the attention of the reader to the two great *navigable lines* that exist from east to west (by the Apure, the Meta, and the Lower Oroonoko), and from south to north, by the Rio Negro, the Cassiquiare, the Upper, and the Lower Oroonoko. By the first of these lines the productions of the province of Varinas* flow towards Angostura, by the Portuguesa, Masparro, the Rio Santo-Domingo, and the Orivante; and the productions of the province of Los Llanos, and the table-land of Bogota†, by the Rio Casanare, the Crabo, and the Pachaquiario. The second line of navigation, founded on the bifurcation of the Oroonoko, leads to the most southern extremity of Columbia, to San Carlos del Rio Negro, and the Amazon. In the present state of Guyana, the

* Vol. iv, p. 389, 454.

† Vol. iv, p. 564—569.

navigation to the south of the Great Cataracts*, of the Oroonoko is scarcely any thing, and the utility of inland communications either with Para, the mouth of the Amazon, or the Spanish Provinces of Jean and Maynas, is founded only on vague hopes. These communications are, in respect to Venezuela, what those of Boston and New York are in respect to the inhabitants of the United States with the coast of the Pacific ocean, across the rocky mountains. - In substituting a canal of 6000 toises, for the portage of Guapore †, a line of inland navigation would be opened from Buenos-Ayres to Angostura. Two other canals of easier construction, might join, the one might unite Atabapo to the Rio Negro ‡ by the Pimichin, rendering it unnecessary for the boats to go round by the Cassiquiare; and the other would do away with the dangers of the rapids of Maypures §. But I repeat, that all the commercial views that are directed to the south of the Great Cataracts, belong to a state of civilization as yet very distant, and in which the four great tributary streams of the Oroonoko (the Carony, the Caura, the Padamo, and the Ventuari), || will become

* Atures and Maypures.

† Vol. iv, p. 305.

‡ Vol. v, p. 166.

§ Vol. v, p. 260.

|| Vol. v, p. 512. 606. See also, Vol. v, p. 216, on the importance of the Guaviare; Vol. v, p. 479, on the isthmus

no less celebrated than the Ohio and the Missouri, on the west of the Alleghanis. At present, the line of navigation from west to east alone engages the attention of the inhabitants, and even the Meta does not yet possess the importance of the Apure and the Rio Santo Domingo. On that line *, 300 leagues in length, the use of steam boats would be of the greatest utility to go up from Angostura to Torunos, the port of the rich province of Varinas. It is dif-

of Rupumiri, and the portages between the Rio Branco, the Essequibo, and the Carony ; and Vol. v, p. 572, on the road by land leading from the Upper to the Lower Oroonoko, and from the Esmeralda to the Erevato, *Ib.*

* The title of a book that has recently appeared (*Journal of an Expedition 1400 miles up the Oroonoko, and 300 up the Arauca, by H. Robinson, 1822*), singularly exaggerates the length of the Lower Oroonoko, and its western tributary streams. A voyage of 1700 English miles would have led the author far into the South Sea. A much more extraordinary geographical error is found in a work composed almost entirely of passages extracted from my *Personal Narrative*, and accompanied with a map which bears my name, although I there search in vain for the town of Popayan. In this *Geographical, statistical, agricultural, commercial, and political account of Columbia, (1822)*, it is said Vol. ii, p. 28, that "the Cassiquiare, long believed to be an arm of the Oroonoko, has been found by M. de Humboldt to be an arm of the Rio Negro." The same assertion is repeated in the *Vollständige, Handbuch der neueren Erdbeschreibung*, Vol. xvi, p. 48, written by a man of great merit, Mr. Hassel. Yet, nearly 23 years ago I went up the Cassiquiare, in the direction of from south to north.

ficult to form an idea of the muscular force exerted by the boatmen, whether they tow their barks, or push their oars (*palanca*) against the bank*, in going up the Apure, the Portuguesa, or the Rio de Santo Domingo, at the time of the high floods. The Llanos present a ridge of partition so little elevated, that between the Rio Pao and the lake of Valencia, as well as between the Rio Mamo and the Guarapiche, communications might be opened by canals, and join, for the facility of inland trade, the basin of the Lower Oroonoko to the coast of the Atlantic and the gulf of Paria†.

United with the local interest of the internal navigation of Venezuela, is another intimately connected with the prosperity of the commercial nations of both hemispheres. Among the five points that appear to present the practicability of opening a direct navigation between the Atlantic ocean and the South sea, three are found in the territory of Columbia. I will not here repeat what I have already observed on this important object, in the first volume of the *Political Essay on New Spain*‡: where I have

* There are windings (*vueltras*) in the Portuguesa and the Apure, and counter-forts that sometimes retain boats a whole day.

† Vol. iv, p. 150 ; Vol. vi, p. 46.

‡ Vol. i, p. cv. 16, &c ; Vol. iv, p. 17. See also my *Atlas Géogr. et Physique de la Nouvelle Espagne*, pl. 15.

shewn that previously to undertaking any labours on either of those points, they ought all to be examined. It is only by investigating an hydraulic problem in its greatest generality, that it can be advantageously solved. Since I left the New Continent no barometric measure or geodesic levelling has been executed to determine the lines of elevation which the projected canals ought to traverse. The different works that have appeared during the war of independence of the Spanish colonies, are confined to the same ideas * which I published in 1800 ;

* I except the useful information given by Mr. Davis Robinson, on the anchorage of Huasacualco, Rio San Juan and Panama. *Memoirs on the Mexican Revolution*, 1821, p. 263. (See also *Edinb. Rev.*, Jan. 1810. *Walton in the Colonial Journal*, 1817, March and June. *Bibl. Universelle de Genève*, Jan. 1823, p. 47 ; *Bibliotheca Americana*, Vol. i, p. 115—129.) “ The bar at the mouth of the Rio Huasacualco has 23 feet of water ; there is good anchorage, and the port can admit the largest ships. The bar of the Rio San Juan, on the eastern coast of Nicaragua, has 12 feet of water ; on one point only there is a narrow pass 25 feet deep. In the Rio San Juan there is from 4 to 6 fathoms, and in the lake of Nicaragua from 3 to 8, English measure. The Rio San Juan is navigable for brigs and sloops.” Mr. Davis Robinson also says “ the western coast of Nicaragua is not so stormy as it was represented to me during my navigation in the South Sea, and a canal issuing at Panama would have the great disadvantage of being continued at a distance of two leagues *in the sea*, because there are only some feet of water as far as the isles Flamengo and Perico.”

it is only by the communications which I have since held with the inhabitants of regions the least visited, that I have been able to obtain some new information. I shall here state the considerations that are most important for the political advantage and the trade of the nations.

The five points that present the practicability of a communication from sea to sea, are situated between the 5th and 18th degrees of north latitude. They all, consequently, belong to the states washed by the Atlantic, to the territory of the Mexican and Columbian confederations, or, to use the ancient geographical denominations, to the intendancies of Oaxaca, and Vera Cruz, and the provinces of Nicaragua, Panama, and Choco. They are :—

THE ISTHMUS OF TEHUANTEPEC (lat. 16° - 18°),
between the sources of the Rio Chimalapa
and the Rio del Passo, which empties itself
into the Rio Huasacualco or Goazacoalcos.

THE ISTHMUS OF NICARAGUA (lat. 10° - 12°),
between the port of San Juan de Nicaragua,
and the coast of the gulf of Papagayo,
near the volcanos of Granada and Bombacho.

THE ISTHMUS OF PANAMA (lat. $8^{\circ} 15'$ - $9^{\circ} 36'$.)

THE ISTHMUS OF DARIEN, or Cupica (lat.
 $6^{\circ} 40'$ - $7^{\circ} 12'$.)

THE CANAL OF RASPADURA, between the Rio Atrato and the Rio San Juan of Choco, (lat. $4^{\circ} 58' - 5^{\circ} 20'$.)

Such is the happy position of these five points, of which the latter will probably be always confined to the *system of small navigation*, or inland communications, that they are placed at the centre of the New Continent, at an equal distance from Cape Horn and the north-west coast, celebrated for the fir trade. Opposed to each (in the same parallel), are the seas of China and India, an important circumstance in latitudes where the trade-winds prevail; all are easily entered by vessels coming from Europe and the United States.

The most northern isthmus, that of Tehuantepec, which Hernan Cortez, in one of his letters to the Emperor Charles 5th (of the 30th October, 1520), calls the *secret of the strait*, has so much the more, of late years, fixed the attention of navigators, that during the political troubles of New Spain, the trade of Vera Cruz was divided between the small ports of Tampico, Tuxpan, and Huasacualco*. It has been calculated that the navigation from Philadelphia to Nootka, and the mouth of the Rio Columbia, which is nearly 5000 marine leagues, taking the ordinary way round Cape Horn, would be

* *Balanza del comercio maritimo de Vera Cruz correspondiente el año de 1811*, p. 19, N^o 10.

shortened at least 3000 leagues, if the passage from Huasacualco to Tehuantepec could be effected by a canal. Having had at my disposal, in the archives of the vice-royalty of Mexico, the memoirs of two engineers*, who were appointed to examine the isthmus, I have been able to form a precise idea of the local circumstances. No doubt the ridge which forms the partition of the waters between the two seas is interrupted by a transversal valley, in which a canal of derivation might be dug. It has been recently asserted, that in the time of high floods this valley is filled with a sufficient quantity of water to admit of a natural passage for the boats of the Indians; but I found no indication of this interesting fact in the different official reports addressed to the viceroy, Don Antonio Bucareli. Similar communications exist, at the period of great inundations, between the basins of the rivers St. Lawrence and Mississipi, that is, between the lake Erie and the Wabash, between the lake Michigan and the river of the Illinois†. The canal of Huasacualco, projected during the able administration of the Count de Revillagigedo, would join the Rio Chimalapa and the Rio del Passo, which is a tributary stream of the Huasacualco; it would be only about 16000 toises long, and from the

* Don Augustin Cramer and Don Miguel del Corral.

† See above, Vol. iv, p. 152; Vol. v, 472.

description given of it by the engineer Cramer, who enjoyed a high reputation, it appears that it would require neither sluices, subterranean galleries, nor the use of inclined planes. It must not, however, be forgotten that no barometric or geodesic levelling has been hitherto executed in the territory comprised between the ports of Tehuantepec and San Francisco de Chimalapa; between the sources of the Rio del Passo and los Cerros de los Mixes. By glancing on the map I have sketched of those countries, we may conceive that the difficulty of this enterprise, which the government of Mexico is about to undertake, consists less in tracing the canal, than in the labours necessary to render the Rio Chimalapa navigable for large vessels, as well as the seven rapids of the Rio del Passo, from the ancient *embarcadère*, on the north of the forests of Tarifa, to the mouth of the Rio Saravia, near the new *embarcadère* de la Cruz. It is to be feared, that, on account of the breadth of this isthmus (which is more than 38 leagues), the windings and the beds of the rivers will oppose obstacles to the project of opening a canal of sea navigation appropriated for vessels trading to China, and the north-west coast of America; it would, therefore, be of the highest importance to establish a line of navigation for small craft, or to improve the road by land,

passing by Chihuitan and Petapa. This road was opened in 1798 and 1801, and the indigos of Guatemala, as well as cochineal and salt provisions, have long been conveyed by that route to Vera Cruz and the island of Cuba.

The isthmus of Nicaragua and that of Cupica have always appeared to me the most favourable for the formation of *canals of large dimensions*, similar to the Caledonian canal, which is 103 feet (French measure) broad at the water's edge, exclusive of the raised way which stops the falling in of the earth; 47 feet broad at the bottom, and $18\frac{1}{2}$ deep. In considering a communication between two seas, capable of producing a revolution in the commercial world, we must not limit our attention to such means as only serve to establish a system of inland navigation by small locks, as in the canals of Languedoc, Briare, or in the Grand Junction, and the Forth and Clyde canals. Some of those canals long appeared to be gigantic enterprises, and indeed they were so when compared with canals of smaller dimensions: but their *mean depth* * not being more than from 6 to $7\frac{1}{2}$ French feet, they cannot give a passage like

* Andreossi, Description of the canal of Languedoc, p. 138. Huerne de Pommeuse, on Navigable Canals, 1822, p. 64, 264, 309. Dupin, Mem. on the Marine, and the Bridges and Highways of France and England, p. 65 and 72. Dutens, Mem. on the Public Works of England. p. 295.

the Caledonian canal, admit merchant vessels of heavy tonnage, and thirty-two gun frigates. It is, however, the practicability of this passage which is discussed in the project of cutting an isthmus in America. The pretended *junction of the two seas*, by the canal of Languedoc, has not spared the navigation a circuit of more than 600 leagues round the Spanish Peninsula; and, however admirable this hydraulic work may be which receives annually 1900 flat-boats, carrying from 100 to 120 tons each, it can only be considered as a means of *inland carriage*: since it very little diminishes the number of vessels that pass through the straits of Gibraltar. It cannot be doubted, that if at any given point of equinoctial America, either in the isthmus of Cupica, or in those of Panama, Nicaragua, or even Huasacualco, two neighbouring ports were joined by a *canal of small dimensions*, (of from 4 to 7 feet deep), it would produce great commercial activity. This canal would act like a rail-way, and small as it might be, would enliven and abridge the communications between the western coasts of America and those of the United States and of Europe. If even in time of war, the long and dangerous passage round Cape Horn has been generally preferred for the exportation of the copper of Chili, bark, the wool of the vigogne of Peru, and the cacao of Guayaquil, to the commercial

entrepôt of Panama and Portobello, it is only on account of the want of the means of transport, and the extreme misery that prevails in those towns, which were so flourishing at the beginning of the conquest. The difficulties here mentioned increase in conveying merchandize from Carthagena or the West Indies, to Quito and Lima; and when sent up in the direction from north to south, by the Rio Chagre, the force of its current must be overcome, like that of the winds and currents of the Pacific ocean.

By rendering the Chagre navigable, employing long steam boats, establishing rail-ways, introducing the camels of the Canaries, which, at the time of my visit, had begun to multiply in Venezuela *, by digging small canals in the isthmus of Cupica, or on the neck of land that separates the lake of Nicaragua from the coast of the South Sea, the prosperity of American industry might be increased, but very indirect influence would be exerted on the general interests of civilized nations. The direction of the trade of Europe and the United States with the *fur coast* (between the mouth of the Columbia and Cook river), with the Sandwich Islands, rich in sandal wood, with India and China, would not be changed. Distant communications require ships of great tonnage, that admit

* See above, Vol. i, p. 78, 121; Vol. iv, p. 182—185, and *Political Essay*, Vol. iv, p. 14.

of being heavily laden, natural or artificial passes, of the mean depth of from 15 to 17 feet, and an uninterrupted navigation, requiring no unloading of the vessels. These conditions are indispensable, and it would be changing the question to confound the canals which, by their dimensions, serve only to facilitate inland communications, and a coasting trade (like the canals of Languedoc and the Clyde, between the Mediterranean and the Atlantic Ocean, or between the Irish and North Seas), with basins and locks capable of receiving the ships employed in the trade of Canton. In a matter that interests every nation which has made some progress in civilization, greater precision should be used than has hitherto been done, respecting a problem, the successful application of which depends principally on the choice of the localities. It would be imprudent, I here repeat, to begin at one point without having examined and levelled others; and it would be above all to be regretted if the works were undertaken on too small a scale; for in works of this description the expence does not augment in proportion to the section of the canals, or the breadth of the water channel.

The erroneous idea which geographers, or rather drawers of maps, have so long propagated of the equal heights of the Cordilleras of America, their prolongation in the form of

walls and continued ridges, and finally, of the absence* of any transversal valley crossing the pretended central chains, has caused it to be generally believed that the junction of the seas is an undertaking of greater difficulty than there has been hitherto reason to suppose. It appears that there are no chains of mountains, not even a ridge of partition, or any sensible line of demarcation† between the bay of Cu-

* I have treated of the source of these errors, Vol. iv, p. 301; Vol. v, p. 41, 456—464, 472, 554.

† This expression surely indicates the facility with which a canal might be traced. A slow ascent of from 40 to 50 toises may, indeed, become at length insensible. I found the great square of Lima 88 toises above the waters of the South Sea, yet, in going from Callao to Lima, this difference of level is scarcely perceived on a distance half as great as that from Cupica to the embarcadero of the Rio Naipi. The geographical position of Cupica is quite as uncertain as the position of the confluence of the Naipi with the Atrato; and this uncertainty appears less strange when we recollect that it extends over the whole southern coast of the isthmus of Panama, and that no mariners, furnished with exact instruments, ever run along the shore in sight of land, between the Capes of Charambira and San Francisco Solano. Cupica is a port of the province of Biruquete, which is but little known, and which the maps of the *Deposito de hydrografico* of Madrid place between Darien and the Choco de Norte. It took its name from that of a Cacique called *Birù* or Biruquete, who reigned over lands in the neighbourhood of the gulf of San Miguel, and who fought, in 1515, as an ally of the Spaniards (*Herera, Dec.*, Vol. ii, p. 8). I have not seen the port of Cupica marked in any Spanish map, but have found

pica, on the coast of the South Sea, and the Rio Naipa, which empties itself into the Atrato, fifteen leagues above its mouth. A biscayan pilot, M. Gogueneche, called the attention of government to this point in the year 1799. Persons worthy of credit, who had made the passage with him from the Pacific Sea to the Embarcadere of Naipi, assured me that they saw no hill in that isthmus of alluvial earth, which they were ten hours in crossing. A merchant of Carthagena, South America, deeply interested in all that regards the statistics of New Grenada, Don Ignacio Pombo*, wrote to me in the month of February 1803:—"Since you ascended the Rio Magdalena to Santa-Fe, and Quito, I have never ceased to take informations respecting the isthmus of Cupica; there are

Puerto Quemado ò Tupica, at $7^{\circ} 15'$ lat. (*Carta del Mar de las Antillas*, 1805. *Carta de la costa occidental de la America*, 1810.) A manuscript sketch in my possession of the province of Choco, confounds Cupica and Rio Sabaleta, lat. $6^{\circ} 30'$; yet, Rio Sabaleta is placed in the maps of the *Deposito*, south, and not north of Cape San Francisco Salano, consequently, $45'$ south of Puerto Quemado. According to the map of the province of Carthagena, by Don Vicenti, London, 1816, the confluence of the Rio Napipi (Naipi?) is $6^{\circ} 40'$ lat. It is to be hoped that these uncertainties of position will soon be removed by observations taken on the spot.

* Friend of the celebrated Mutis, and author of a little work on the trade of quinquina (*Noticias varias sobre las quinas oficinales*, *Carth. de Indias*, 1817), which I have several times had occasion to quote.

only from 5 to 6 leagues from that port to the Embarcadere of Rio Naipi, and the whole territory is a plain (*tereno enteramente Llanos*).” From the facts I have mentioned it cannot be doubted that this part of the northern Choco is of the highest importance for solving the problem under our consideration; but, in order to form a precise idea of this absence of mountains at the southern extremity of the isthmus of Panama, we must bear in mind the general outline of the Cordilleras. The chain of the Andes is divided at the 2° and 5° of latitude into three chains*, and the two longitudinal vallies that separate those chains form the basins of the Magdalena and the Rio Cauca. The eastern branch of the Cordilleras inclines towards the north-east, and joins itself by the mountains of Pamplune and Grita, to the *Sierra Nevada de Merida*, and the chain of the coast of Vene-

* Eastern Chain, that of Suma Paz, Chingasa, and Guachaneque, between Neiva and the basin of Guaviare, and Santa-Fe de Bogota and the basin of Meta; intermediary chain, that of Guanacas, Quindio, and Erve (*Herveo*), between the Rio Magdalena and the Rio Cauca, the la Plata and Popayan, and between Ibaguè and Carthago; western chain, between the Rio Cauca and the Rio San Juan, the Cali and Novita, and between Carthago and Taddò. (See my Geogr. Atlas, pl. 24.) This last chain, which separates the provinces of Popayan and Choco, is generally very low; it is, however, said to rise considerably in the mountain of Torà, at the west of Calima. (*Pombo, de las Quinas*, p. 67.)

zuela, and the intermediate and western branches of Quindio and Choco, run into one another in the province of Antioquia, between the 5° and 7° of latitude, and form a groupe of mountains of considerable breadth, stretching by the *Valle de Osos* and the *Alto del Viento*, towards Cazeres, and the elevated savannahs of Tolu. Further west, in the *Choco del Norte*, the mountains lower to such a degree, that, between the gulf of Cupica and the Rio Naipi, they disappear altogether. It is the astronomical position of that isthmus and the distance from the mouth of the Atrato to its confluence with the Rio Naipi* that should be fixed with

* The geography of that part of America, between the mouth of the Atrato, the Cape Corientes, the Cerro de Tora, and Vega de Supia, is in a most deplorable state. It is only more to the east, in the province of Antioquia, that the labours of Don Jose Manuel Restrepo present some points of which the position is astronomically fixed. From Cupica to Cape Corientes, the distance by land is computed to be from 12 to 14 (?) marine leagues. From Quibdo (Zitara), where resides the *Teniente Gobernador*, (the corregidor inhabits Novita,) it takes from 7 to 8 days of navigation to go down as far as the mouth of the Atrato. An error, common to every common map (excepting that of M. Talledo), is placing Zitara 1° too much to the north, sometimes at the mouth of the Atrato, sometimes at its confluence with the Naipi. From San Pablo, situated some leagues above Tado, on the right bank of the Rio San Juan, to Quibdo or Zitara, is only one day's journey.

precision ; we do not know whether sloops can ascend to this point.

After the lake of Nicaragua, Cupica, and Huasacualco, the isthmus of Panama merits the most serious attention. The practicability of forming a canal for ship navigation depends, at the same time, on the height of the point of partition, and the configuration of the coasts ; that is, on the *maximum* of their nearness to each other. So narrow a neck of land might, by its direction, have escaped the destructive influence of the current of rotation ; and the supposition that the greatest height of the mountains must correspond to the *minimum* of the distance between the coasts, would not, in our days, be justified even by the principles of merely systematic geology. Since I published my first work on the junction of the seas, we remain, unfortunately, in the same ignorance respecting the height of the ridge which the canal must pass over. Two learned travellers, MM. Boussingault and Rivero, levelled the Cordilleras from Caraccas to Pamplona, and from thence to Santa-Fe de Bogota, with a precision superior to any thing I could attempt in that kind of research ; but on the north-west of Bogota, from the Andes of Quindiu and Antioquia, levelled by M. Restrepo and myself, as far as the table land of Mexico, in the 12° of latitude of *central America*, not one single mea-

sure of height has been made since my return to Europe. It is much to be regretted that, towards the middle of the last century, the French academicians crossed the isthmus of Panama without thinking of opening their barometer at the point of the partition of the waters. Some observations which Ulloa has repeated, as by chance, have led me to conclude that from the mouth of the Rio Chagre to the embarcadere of Cruces, there is a difference of level of 210, or 240 feet *. From the Venta de Cruces to Panama you ascend rapidly, and then descend during several hours towards the South Sea. It is, therefore, between this port and Cruces that the threshold, or point of partition, is placed, which the canal must pass over, if the idea be persisted in of giving it that direction. I shall here mention that it would suffice, in order to enjoy the view of the two oceans at once, that the mountains of the *line of elevation* in the isthmus were 580 feet high, that is, only a third higher than the Naurouse, in the chain of the Corbières, which is the point of partition of the canal of Languedoc. Now this simulta-

* Near Chepo and the village of Penomène for instance (*MSS. of the Curate Don Juan Pablo Robles*). The mountains seem to rise towards the province of Veragua, where even wheat is cultivated in the district of Chiriqui del Guami, near the village of la Palma, Franciscan mission, dependent on the college of the Propaganda de Panama.

neous view of the two seas is remarked in some parts of the isthmus as being very extraordinary; from which we may, I think, conclude that the mountains are, in general, not an hundred toises high. Some feeble indications of the temperature and geography of the native plants, lead me to think that the ridge over which the road passes from Cruces to Panama, is not 500 feet high; Mr. Robinson * supposes it at most 400 feet. According to the assertion of a traveller †, who describes with the most ingenuous simplicity what he has seen, the hills that compose the central chain of the isthmus, are separated from each other by vallies, “which leave a free course to the passage of the waters.” The researches of the engineers who are charged to explore those countries should be principally directed to the discovery of the transversal vallies. We find examples in every country of natural openings across the ridges. The mountains between the channels of the Saone and the Loire, which the canal of the Centre would have had to pass over, were eight or nine hundred feet high; but a neck of land or interruption of the chain near the reservoir of Long Pendu, furnished a passage 350 feet lower.

If we are not at all advanced in the know-

* *Memoir on the Mexican Revolution*, p. 269.

† *Lionel Wafer, Description of the Isthmus of America*, 1729, p. 297.

ledge of the heights of the isthmus of Panama, the last labours of M. Fidalgo, and other Spanish navigators, have at least furnished more precise statements on its configuration, and the *minimum* of its breadth. This *minimum* is not 15 miles, as the first maps of the *Deposito hydrografico* indicate, but $25\frac{1}{4}$ miles (60 to a degree), that is, $8\frac{1}{2}$ marine leagues, or 24,500 toises; for the dimensions of the gulf of San Blas, called also Ensenada de Mandinga, on account of the small river of that name which flows into it, have given rise to great errors. This gulf penetrates into the land 17 miles less than was supposed in 1805, in taking the plan of the archipelago of the *Islas Mulatas**. Whatever credit the last astronomical observations appear to merit, and on which the map of the isthmus is founded, published by the Royal Deposit of the Marine of Madrid in 1817, we must not forget that these operations comprehend only the northern coast, which appears never yet to have been connected either by a chain of triangles, or chronometrically (by the transport of time), with the southern coast.

* See my Political Essay, Vol. iv, p. 348. In comparing the two maps *Deposito hydrografico de Madrid*, bearing the title *Carta esérica del Mar de Antillas y de las Costas de Tierra Firme desde la isla de la Trinidad hasta el golfo de Honduras*, 1806, and the *Quarto Hoja que comprehende la provincia de Cartagena*, 1819, we see how well founded were the doubts

Now, the problem of the breadth of the isthmus does not solely depend on the determination of the latitude. The government of Columbia hav-

I announced fifteen years ago, on the relative position of the most important points of the southern and northern coasts of the isthmus. Panama was anciently believed (*Don Jorge Juan. Travels in South America, Vol. i, p. 99*), to be 31' to the west of Portobello. La Cruz (1775), and Lopez (1785) have followed this supposition, founded only on a plan of the direction of the route, taken with a compass. But in 1802, Lopez (*Mapa del Reyno de Tierra Firme y sus provincias de Veragua y Darien*) began to place Panama 17' to the east of Portobello. In the map of the *Deposito* of 1805, this difference of meridians was reduced to 7'; finally, the map of the *Deposito* of 1817 places Panama 25' east of Portobello. The following are other differences of latitude on which the breadth of the isthmus depends :—

Map of 1809. Map of 1817.

Southern coast between the mouths
of the Rio Juan Diaz and the Rio
Jucume on the east of Panama, in
the meridian of Punta San Blas

8° 54' 9° 2½'

Northern coast forming the bot-
tom of the gulf Mandinga, or
of San Blas, on the south of the
Islas Mulatas

9° 9' 9° 27¾'

From this difference of latitudes
the results are, for the *minimum*
of the breadth of the isthmus,
nearly 14,250 toises, according
to the map of 1805, and nearly
24,463 toises, according to the
map of 1817.

Punta San Blas, N.W. part of the
gulf of Mandinga

9° 33' 9° 34½'

ing lately received excellent barometers, constructed by M. Fortin, may direct the geodesic levellings, which are always slow and expensive, to be preceded by barometric levellings, which in the torrid zone are extremely exact. I am assured that in those countries correspondent observations may be dispensed with, on account of the marvellous regularity of the horary variations, without fearing errors of 4 or 5 toises.

The points which ought to be carefully examined are the following:—the *Isthmus of Huasacualco*, between the sources of the Rio Chimalapa and the Rio del Passo; the *Isthmus of Nicaragua* *, between the lake of that name, and the

This cape not having been carried to the north in the same measure as the bottom of the gulf, near the mouth of the Rio Mandinga, it thence results, that, according to the first map, the gulf enters 24', and according to the second, 7'. It is probable that the changes of latitude which result from the last expedition of M. Fidalgo, must be attributed to the want of *artificial horizons*, and to the difficulty of observing the sun with instruments of reflexion, amidst a group of islands, and above a sea where the horizon is not clear. More to the west the mean breadth of the isthmus, between Castillo de Chagres, Panama, and Portobello, is 14 marine leagues; the *minimum* of its breadth (8 leagues) is two or three times less than the breadth of the isthmus of Suez, which M. Le Pere finds to be 59,000 toises.

* If the question here agitated related only to *canals of small navigation*, fit solely to enliven inland trade, I should also have named the coast of Verapaz and Honduras. The

insulated volcanoes of Granada and Bombacho ; the *Isthmus of Panama*, between the Venta de Cruces, or rather between the Indian village of Gorgona, 3 leagues below Cruces, and the port of Panama, between the Rio Trinidad and the Rio Caymito ; the bay of Mandinga and the Rio Juan Diaz ; the Ensenada de Anachacuna (west of the Cape Tiburon) and the gulf of San Miguel, in which the Rio Chuchunque, or Tuyra loses itself ; the *Isthmus of Cupica*, between the coast of the South Sea and the confluence of the Rio Naipi with the Rio Atrato ; and finally, the *Isthmus of Choco*, between the Rio Quibdo, upper tributary stream of the

Golfo Dulce in the meridian of Sonfonate, runs more than 20 leagues into the land, so that the distance of the village of Zacapa (in the province of Chiquimala, near the southern extremity of the *Golfo Dulce*) is only 21 leagues from the coast of the Pacific Ocean. The rivers of the north approach the waters which the Cordilleras of Izalco and Sacatepeques empty into the South Sea. We find on the east of *Golfo Dulce*, in the *partido* of Comayagua, the Rio Grande of Motagua, or Rio de las *bodegas* de Gualan, the Rio le Camalecon, the Ulua, and the Lean, which are navigable for large boats, 30 or 40 leagues inland. It is very probable that the Cordillera, which here forms the ridge of partition between the two seas, is divided by some transversal vallies. M. Juarros, in the interesting work he has published at Guatemala, shews us that the fine valley of Chimaltenango pours its waters at the same time on the southern and northern coasts. Steamboats will one day give activity to the trade on the rivers of Motagua and Polochic.

Atrato, and the Rio San Juan de Charambira. Persons accustomed to take accurate observations, if furnished only with barometers, instruments of reflection, and time-keepers, might in a few months solve problems, which, during centuries, have interested all the commercial nations of both worlds. If, in the enumeration of the countries which present advantages for the junction of the two seas, I have not passed over in silence the Isthmus of Choco, that is the *platiniferous* soil, extending from the river San Juan de Charambira to the Rio Quibdo, it is on account of its being the sole point on which a communication exists since the year 1788, between the Atlantic Ocean and the South Sea. The small canal of Raspadura, which a monk, the curate of Novita, caused to be dug by the Indians of his parish, in a ravine periodically filled by natural inundations, facilitates the inland navigation on a length of 75 leagues, between the mouth of the Rio San Juan, below Noanama, and that of the Atrato, which bears also the names of Rio Grande del Darien, Rio Dabeiba, and Rio del Choco *. During the

* I might have added the synonymous name of San Juan (del Norte), if I did not fear confounding the Atrato with the Rio San Juan of Nicaragua, and the Rio San Juan of Charambira. The name Dabeiba is that of a female warrior, who reigned, according to the first historians of the conquest, in the mountainous countries between the Atrato and

wars which preceded the revolution of Spanish America, considerable quantities of cacao of Guayaquil were conveyed this way to Carthagena. The canal of Raspadura, of which I believe I gave the first intimation in Europe, affords a passage only for small boats; but it might be easily enlarged * if the streams were joined to it known by the names of Cano de las

the source of the Rio Sinu (Zenu) on the north of the town of Antioquia. According to the work of Petrus Martyr d'Anghiera (*Oceanica*, p. 52), this woman was confounded in a local mythology with a divinity of the lofty mountains, whence dart the lightnings. We recognize, in our days, the name of Dabieba, in that of the hills Abibi or Avidi, given to the Altos del Viento, in latitude 7° 15' west of the Boca del Espiritu Santa, on the banks of the Cauca. Where is the volcano of Ebojito, which La Cruz and Lopez place in the almost desert countries between the Rio San Jorge, a tributary stream of the Cauca, and the source of the Rio Murry, a tributary stream of the Atrato? The existence of this volcano appears to me very doubtful.

* *Relacion del estado del Nuevo Reyno de Grenada que hace et Arzobispo Obispo de Cordova a su sucesor el Exc. Sr. Fray, Don Francisco Gil. y Lemos 1789*, fol. 68. (A manuscript written by the Secretary of the Archbishop-Viceroy, Don Ignacio Caverro.) *Representacion que dirige Don Jose Ignacio Pombo al Consulado de Cartagena en 14 de Mayo 1807, sobre el reconocimiento del Atratoes Zinù y San Juan*, fol. 38 (MS.) The ravine of Raspadura, or Bocachica, now receives only the waters of Quebradas de Quiadocito, Platanita, and of Quiado. According to the ideas I acquired at Honda and Vilela, near Cali, from persons in the trade of (rescate) the gold dust of Choco, the Rio Quibdo, which communicates

Animas, Cano del Calichi, and Aguas claras. *Feeding trenches* are easily established in a country like Choco, where it rains during the whole year, and where thunder is every day heard. The barometric observations of the unfortunate Caldas not having been published, we

with the canal of the Mina de Raspadura, joins the Rio Zitura and the Rio Andageda, near the village of Quibdo, vulgarly called Zitura; but in a manuscript map which I have just received from Choco, and on which the canal of Raspadura (lat. $5^{\circ} 20'$?) joins both the Rio San Juan and the Rio Quibdo, a little above the Mina de las Animas, the village of Quibdo is placed at the confluence of the small river of that name, with the river Atrato, which has received three leagues higher the Rio Andageda, near Lloro. The grand Rio San Juan receives successively from its mouth (lat. $4^{\circ} 6'$) at the south of the Punta de Charambira, in going up towards the N.N.E., the Rio Calima, the Rio del Nò (above the village of Noanama), the Rio Tamana, which passes near the Novita, the Rio Irò, the Quebrada de San Pablo, and finally, near the village of Taddò, the Rio de la Platina. The province of Choco is inhabited only in the vallies of those rivers: it has three trading communications; in the north with Carthagená by the Atrato, the banks of which are entirely desert from $6^{\circ} 45'$ of latitude; in the south with Guayaquil, and, before 1786, with Valparaiso, by the Rio San Juan; in the east with the province of Popayan, by the Tambo de Calima, and by Cali. From Taddò to Noanama, in going down the Rio San Juan, takes one day; to the Tambo de Calima (lat. $4^{\circ} 12'$) 4 days; and from the Tambo to Cali (lat. $3^{\circ} 25'$), in the valley of Cauca, 5 days; during which you cross the Rio Dagua, or San Buenaventura, and the western Cordillera of the Andes of Popayan. I have entered into these local de-

are ignorant of the height of the point of partition between San Pablo and the Rio Quibdo. We only know that there are some *gold-washings* in those countries, at the height of from 360 to 400 toises above the level of the ocean, and that they are never found at a lower elevation than 50 toises. The position of the canal, in the interior of the continent, its great distance from the coast, and the frequent falls (*raudalitos y choreras*) of the rivers, which it is necessary to ascend and descend, in order to pass from one sea to another, from the port of Charambira to the gulf of Darien, are obstacles too difficult to be overcome, in order to establish *a line of great navigation* across the Choco. But that line, even without furnishing a passage for vessels of great tonnage, will not be less worthy of the attention of a wise administration; it will give life to inland trade

tails, because the maps confound the ravine of Raspadura, which serves as a canal, with the *portages* of Calima and San Pablo. The *arastradero* of San Pablo leads also to the Rio Quibdo, but several leagues above the mouth of the canal of Raspadura. The road of the *arastradero* of San Pablo is usually taken for the conveyance of merchandize (*generos*) sent from Popayan, by Cali, Tambo de Calima, and Novita, to *Choco del Norte*, that is, to Quibdo (Zitara). The geographer La Cruz, calls the whole isthmus between the sources of the Rio Atrato and the Rio San Juan, *Arastradero del Torò*. (On the height of the *Zone of Gold*, *Semanario de Santa Fe*, Vol. i, p. 19.)

between Carthagena and the province of Quito, and between the port of Santa Marta and Peru. We shall observe, at the close of this discussion, that the ministry of Madrid never enjoined the viceroy of Santa-Fe to fill up the ravine of Raspadura, or to punish with death those who attempted to re-establish a canal at Choco, as has been asserted in a work recently published. This suspicious policy may indeed remind us of the order given to the Viceroy of New Spain during my stay in America, to root up the stocks of the vines in the *provincias internas*; but the hatred borne towards the culture of the vine in the colonies was owing to the influence of some merchants of Cadiz, who were jealous of what they called their ancient monopoly, while a small ravine that crosses the forests of Choco, escaped more easily the vigilance of the ministry, and the jealousy of the mother country*.

After having examined the localities of the different points of partition, according to the imperfect information which I have hitherto been able to collect, it remains to prove, by the analogy of what men have executed in the state of modern civilization, the possibility of realizing the junction of the two oceans. In proportion as problems become complicated, and de-

* Robinson, Vol. ii, p. 266.

pend on a great number of elements by their nature variable, is the difficulty of fixing the *maximum* which the efforts of intelligence and the physical power of nations are capable of exerting. During the thousands of years that have elapsed from the unknown period of the construction of the pyramids of Ghizeh, to that of our gothic steeples and the cupola of Saint Peter's, men have not raised one edifice exceeding 450 feet in height *; but shall we presume to conclude from this fact, that modern architecture cannot go beyond an elevation scarcely equal to forty times that of the edifices constructed by white ants? If the question here agitated respected only canals of a mean size, having a depth of only from 3 to 6 feet, and serving merely for inland navigation, I could mention canals long since executed, which pass over ridges of mountains of from 300 to 580 feet high†. England alone, of which the canals

* Ancient French measure, *pied de Roi*, or 75 toises.

† The following are the partial statements for ten canals, arranged according to the order of the height of their points of partition :—

NAMES OF THE CANALS.

*Elevation of the
Points of Partition
in French feet.*

Canal of Languedoc, or of the South. (Length, 123,730 toises; mean depth, 6 f. 2 in.); number of locks, 100; expence of construction, in the time of Louis the 14th, nearly 16,280,000 francs; at the present value of money 33 millions of francs. G. N. 582

are 584 marine leagues in length, contains nineteen that cross the points of partition between

| NAMES OF THE CANALS. | <i>Elevation of the Points of Partition in French feet.</i> |
|---|---|
| <i>Leominster Canal.</i> (Length, 37,745 toises ; expence, 14 millions of francs). L. N..... | 465 |
| <i>Huddersfield Canal.</i> (Length, 15,900 toises ; expence 6½ millions of francs): L. N..... | 409 |
| <i>Leeds and Liverpool Canal.</i> (Length, 106,700 toises ; number of locks, 91 ; expence 14,400,000 francs). G. N. | 404 |
| <i>Canal du Centre</i> , between the Saone and the Loire. (Length, 58,300 toises ; depth, 5 feet ; number of locks, 80 ; expence, 11 millions of francs). G. N. ... | 403 |
| <i>The Grand Trunk Canal, or that of the Trent and Mersey.</i> (Length, 272,000 toises ; depth, from 4 to 5 feet ; number of locks, 75 ; expence, 9½ millions of francs). G. N. ... | 382 |
| <i>Grand Junction Canal.</i> (Length, 74,400 toises ; depth, 4 f. 3 in. ; number of locks, 101 ; expence, 48 millions of francs). G. N..... | 370 |
| <i>Canal de Briare</i> , constructed in 1642, the most ancient of the canals, at the point of partition. (Length, 14,500 toises ; depth, 4 feet ; number of locks, 40 ; expence, 10 millions of francs). G. N. | 243 |
| <i>Forth and Clyde Canal.</i> (Length, 34,000 toises ; depth, 7½ feet ; number of locks, 39 ; expence, 10 millions of francs). | 155 |
| <i>Caledonian Canal.</i> (Length, 18,500 toises ; number of locks, 23 ; depth, 18 f. 9 in. ; expence, 19 millions of francs). G. N. | 88 |

The initials of the words *Great and Little Navigation* have been added, to distinguish the canals, which, according to the

the rivers of the western and the eastern coast. Engineers have long so little regarded 580 feet, that is, the height of the *bief* of division of Naurose, on the canal of the south, as the *maximum* which may be reasonably attained in this kind of hydraulic construction, that Mr. Perro-net, a man justly celebrated, considers the project as very practicable, of forming a canal in Burgundy, between the Yonne and the Saone, which must pass over a height (near Pouilly), of 921 feet above the level of the Yonne at low water. In combining inclined planes and railways with lines of navigation, boats have passed into the Monmouthshire canal at a thousand feet of elevation ; but such works, so important for the prosperity of the inland trade of a country, do not constitute what may be called *canals for sea navigation*.

The discussion with which we are at present occupied, regards the communication from sea to sea by vessels fitted, from their structure and tonnage, for the India and Chinese trade. Now, the industry of the nations of Europe presents two examples of these oceanic communications, on a very great scale ; one, in the canal of the Eyder or Holstein, the other in the Caledonian

English usage, are thus classified. (*Dutens, Mem. sur les travaux publics*, p. 81, 91, 94.) The locks of the first class are at least 64 feet long, and 14 feet wide ; the locks of the second class are also 64 feet long, but only 7 feet wide.

canal. The former of those works, constructed from 1777 to 1784, joins the Baltic with the North Sea, between Kiel and Tonnigen ; having only six locks, and passing over a bar of 28 feet. It separates the continental part of Denmark from Germany, and enables vessels of an ordinary size to avoid the dangerous passage of the Cattegat and the Sound. It receives ships of from 140 to 160 tons*, coming from the ports of Russia and Prussia, and going to England, the Mediterranean, Philadelphia, the Havannah, and the western coast of Africa. These vessels draw only from 8 to 10 feet of water†. Being generally constructed in Holland or in the Baltic, the ribs are very flat, and they are consequently spacious without drawing much water. The Caledonian canal, not the most useful, but unquestionably the most magnificent hydraulic work hitherto undertaken, is an *oceanic canal* in the strictest sense of the terms. It unites the eastern and western seas of Scotland, between Inverness and Fort William, in a neck of land across which nature

* From 75 to 90 *Last*. The size of the flat bottomed boats that sail on the canals of great navigation in England, is generally but from 40 to 50 tons. On the canal of Languedoc, the largest boats are of 120 tons.

† The feet are always the ancient measure of France, in *pieds de roi*, of which 6 make 1^m,949, when the contrary is not expressly indicated.

seems to have traced the line of junction. The navigable part is 17 leagues in length (20 to a degree), of which there are only $6\frac{1}{2}$ of artificial excavation; the remainder forms a natural navigation on the lakes of Oich and Lochy, separated heretofore by a rocky ridge. This canal was completed in the space of 16 years, admits the passage of frigates of 32 guns, and of large ships employed in foreign trade. Its mean depth is 18 feet 8 inches ($6^m,09$), and its breadth at the bottom, 47 feet ($15^m,2$). The locks, 23 in number, are 150 feet long, and 37 feet wide.

Being guided in the practical views presented at the end of this chapter, only by the analogy of the labours already performed by man, I shall first observe, that the breadth of the isthmuses of Cupica and Nicaragua, in which the height of the ridge of partition is very inconsiderable, is nearly the same as the breadth of the land crossed by the artificial part of the Caledonian canal. The isthmus of Nicaragua, by the position of its inland lake, and the communication of that lake with the Atlantic, by the Rio San Juan, presents several features of resemblance with that neck of land in the Scotch Highlands where the river Ness forms a natural communication between the mountain lakes and the gulf of Murray. At Nicaragua, as in the Scotch Highlands, there would be but one

narrow ridge to pass over ; for, if the Rio San Juan in a great part of its course is from 30 to 40 feet deep, as is asserted, it would only require to be rendered navigable in some parts by means of weirs or lateral channels *.

With respect to the depth of the oceanic

* This point, near the openings of the wood of Campeche, (*Cortes de Madera*) had attracted the attention of the commercial world long before the publication of the excellent work on Jamaica, by Mr. Bryan Edwards. See *La Bastide, Mem. sur le passage de la mer du Sud à la Mer du Nord*, p. 7. There is a triple possibility of forming the canal of Nicaragua (as I have already stated in the *Political Essay*) either from the lake of Nicaragua to the gulf of Papagayo, or from that lake to the gulf of Nicoya, or from the lake de Leon, or Managua, to the mouth of the Rio de Tosta (and not from the lake de Leon to the gulf of Nicoya, as is asserted by the usually well-informed editor of the *Biblioteca Americana*, 1823, *Agosto*, p. 120.) Does there exist a river that flows from the lake of Leon to the Pacific Ocean ? Of this I doubt, although ancient maps mark the communications between the lakes and the sea (*Political Essay*, Vol. i, p. 25). The distance from the south-east extremity of the lake of Nicaragua to the gulf of Nicoya, is very differently indicated (from 25 to 48 miles) in Arrowsmith's map of South America, and in the fine map of the depot of Madrid, bearing the title of *Mar de las Antillas*, 1819. The breadth of the isthmus between the eastern shore of the lake of Nicaragua, and the gulf of Popagayo is from 4 to 5 marine leagues. The Rio San Juan has three mouths, of which the two smallest are called *Taure* and *Caño Colorado*. In one of the isles of the lake of Nicaragua, that of Ometep, there is a volcano, said to be still burning.

canal projected in central America, it might, I think, be even less than the depth of the Caledonian canal. Such is the change which the new systems of commerce and navigation have produced within 15 years, in the capacity or the structure of the ships most commonly employed in the intercourse with India and China, that in examining with attention the official list of vessels, which during two years (from July 1821 to June 1823), have traded from London and Liverpool to those two countries, we find, on a total of 216 vessels, *two-thirds* below 600 tons, one-fourth between 900 and 1400 tons, and one-seventh below 400 tons*. In France, the *mean tonnage* in the ports of Bordeaux, Nantes, and Havre, of vessels trading to India, is 350 tons. The nature of the operations undertaken in the most distant latitudes, determines the capacity of the vessels employed; for instance, to bring indigo from Bengal, it may appear sufficient, and even preferable, to send a vessel of 150 to 200 tons. The system of small expeditions is preferably adopted in America, where all the advantages are felt of prompt lading, and a rapid circulation of capital. The average size of the American vessels

* *East India Shipping*—return to the order of the House of Commons, London, 1823. I have reduced the English into French tonnage, the latter being 10 p. c. less.

that go to India round the Cape of Good Hope, and to Peru round Cape Horn, is 400 tons; the whale-boats of the South Sea are only 200 or 300 tons. In Spanish America, from ancient custom, ships of much greater tonnage are employed in time of peace. At Vera Cruz for example, where there entered, during my stay in Mexico, from 100 to 130 vessels coming from Spain, their size was generally 500 tons. It is only in time of war that shipments of 300 tons are made for Cadiz.

These statements sufficiently prove, that in the present commercial state of the world, such a canal of junction as is projected between the Atlantic Ocean and the South Sea, would be sufficiently large, if by its section and the capacity of its locks, it could admit the passage of vessels of from 300 to 400 tons burden. This ought to be the *minimum* of its dimensions, and it supposes, after what we have indicated above, a capacity nearly double that of the canal of Holstein, but much less than that of the Caledonian canal; the former receiving vessels of from 150 to 180 tons, and the latter, frigates of 32 guns, and merchant ships of more than 500 tons. It is true that the tonnage determines only by approximation the quantity of water a ship draws, since the excellence or defects of its construction alters at the same time its

speed, and its capacity for stowage. We may, however, admit* that a mean depth of from $15\frac{1}{2}$ to $17\frac{1}{2}$ feet will suffice for a canal of junction intended for vessels of 300 to 400 tons; this is fifteen inches less than the celebrated engineers, Messrs. Rennie, Jessop, and Telford, have given to the Caledonian canal, and double that of the canal of the Forth and Clyde.

The gigantic works of Europe which we have mentioned as examples, and the construction of which has not cost more than 4 millions of piastres, have had very small heights to pass over, less than from 90 to 100 feet. The canals which cross the ridges of partition of from three

* I suppose that a foot and a half of water may suffice under the keel of a vessel that navigates in a canal of which the waters are perfectly calm, and which is carefully cleaned. Notwithstanding the great difference of construction, which has an equal influence on the quantity of water a ship draws, we may, by approximation, admit the following statements :

| <i>Burden.</i> | <i>Draught of the Vessel.</i> |
|---------------------|-------------------------------|
| 1200—1300 tons..... | 19—20 feet. |
| 600— 700..... | 17—18 |
| 300— 400 | 14—16 |
| 200— 300 | 11—12 |

In a matter which interests every man capable of reflecting on the future destinies of nations, and the progress of general civilization, I thought it was proper to give all the statements on which the practical solution of the problem depends. The canal of Crinan, in Scotland, is also from 11 to 14 feet deep, on 3 leagues of length.

to six thousand feet, have been hitherto only from 4 to 6 feet deep. The difficulties naturally increase with the elevation of the ridge of partition, the depth of the excavations, and the size, if not the multiplicity, of the locks. It is not enough to dig the canal; it must be ascertained that the quantity of water derived from the upper ground is equal to the demand for filling it; that is, sufficient to feed the canal, and to replace what is lost by the locks, by evaporation, and by filtration. We have seen above that the local circumstances in the isthmuses of Cupica and Huasacualco are such, that the obstacle to be overcome in effecting the junction of the seas, is less the height of the ridge which the canal must cross, than the state of the beds of the rivers (Naipi and Rio del Passo) which must be rendered navigable, either by being excavated by machines worked by a steam-engine, or by weirs and lateral derivations. In the intendance of Nicaragua, the great depth of the Rio San Juan, and that of the lake of Nicaragua, or *laguna de Granada*, which is, according to Mr. Robinson, from 17 to 40; and, according to Mr. Juarros, from 20 to 55 feet, seems to render such labors superfluous*. The mountains of the isthmus of Panama rise probably to the elevation of the basins of partition

* *Compendio de la Hist. de Guatemala*, T. i, p. 51. This work is 12 years anterior to that of Mr. Robinson.

of the *Canal du Centre*, (between Châlons and Digoin), and of the Grand Junction canal, (between Brentford and Braunston): the mountains of the isthmus may be still more elevated, and perhaps are divided by no transversal valley from south to north. We think that more advantageous spots may be chosen; but we ought here to observe that the height of the ridge is an inseparable obstacle to the junction of seas, only, when there is not at the same time a sufficient quantity of upper waters fit to be conveyed to the point of partition. Seven or eight locks crowded together on the canals of Briare and Languedoc *, and regulating falls of water of from 64 to 70 feet, long appeared an extraordinary work, notwithstanding the small dimension of the locks, and the depth of the canals, of which the section does not exceed 5 to 6 feet. The *Staircase of Neptune*, in the Caledonian canal, presents a similar accumulation of locks, on a scale so much more extensive, that frigates can rise in a small space of time to the height of 60 feet. Now, that work only cost 257,000 piastres, that is five times less than three pits of the mine of Valenciana in Mexico; and ten *Staircases of Neptune* would cause ships of 600 tons to pass over a ridge of partition 600 feet higher than the chain of the Corbières, between the Mediterranean and the

* Near Rogny and Fonseranne.

Atlantic. I discuss here the possibility only of executing works to which there will certainly be no need to have recourse.

The expence of water for feeding a canal increases, with the extent of the filtrations, the frequency of passages, or of the lockages (*exclusée* *) and with the size of the chambers of locks, but not with their number. The facility of collecting an enormous mass of rain waters within the tropics, is beyond what the engineers of Europe can imagine. When Lewis the 14th ordered the gardens of Versailles to be embellished, Colbert was made to hope that the rains would furnish, on a surface of 12,700 hectares of plains which communicated with ponds and reservoirs, 9 millions of cubic toises of water †. Now the rains in the vicinity of Paris amount annually only to from 19 to 20 inches, while within the torrid zone in the New World, above all, in the region of the forests, the quantity is at least from 100 to 112 inches ‡. This im-

* The *exclusée* is the successive filling of the lock to enable the boats to ascend or descend in a canal, at the point of partition.

† Only $\frac{1}{150}$ could be collected; the remainder was lost by filtrations, and it became necessary to construct the machine of Marly: *Huene de Pommeuse, sur les canaux navigables. Supplément*, p. 45.

‡ See above, Vol. ii, p. 248, 344, 743. The mean quantity of rain that falls annually at Kendal, on the western side of England, is 57 inches; at Bombay 72 and 106

mense difference shews that by the junction of the springs, by feeding-trenches, and well-established reservoirs, an able engineer might avail himself in central America, of circumstances which are wholly dependent upon the

inches ; at St. Domingo 113 inches. (*Arago Annuaire du Bur. des Long.*, 1824, p. 165.) M. Antonio-Bernardino Pereira Lago, colonel of infantry of the corps of engineers, at Brazil, thinks he found, in the year 1821 only, at San Luis do Maranhao, (lat. $2^{\circ} 29'$ south), 23 feet 4 inches, 9·7 lines, English measure, which make near 260 French inches. We might be inclined to doubt this prodigious quantity of rain ; yet I am in possession of the barometric, thermometric, and ombrometric observations which M. Pereira Lago affirms were made by him, *day by day at those different periods*. These Brazilian observations are published in the *Annaes das Sciencias das Artes et das Letras*, p. 54—79 ; and the observer who describes the instruments he employed, says expressly, in the *resumo das observacoes meteorologicas*, that the plane on which the rain fell was exactly of the same diameter as the cylinder which contained the scale ; this diameter was only 6 inches (English). I wish this important observation may be verified at Maranhao, and repeated in other parts of the tropics, where the rains are abundant ; for instance, at Rio Negro, Choco, and the Isthmus of Panama. The quantity indicated by M. Pereira Lago, is $2\frac{1}{8}$ times greater than what has been observed at the mean term, at the Isle of St. Domingo ; but the quantity of water that falls on the western coast of England also exceeds three times that which is collected annually at Paris. There exists very considerable differences in latitudes, that are near each other. Captain Roussin relates that 151 inches of rain-water fell at Cayenne, in the month of February only.

climate. Notwithstanding the high temperature of the air, the loss caused by evaporation * will scarcely counterbalance, in deep basins, the advantages of the tropical rains. The experiments made at the Pontinspar marshes, by M. de Prony, and at the canal of Languedoc †, by MM. Pin and Clausade, indicate, in the latitudes 41° and $43\frac{1}{2}^{\circ}$, a produce of annual evaporation of 348 lines. The experiments which I made in the tropics, are not sufficiently numerous to draw a general result; but in supposing the atmosphere equally calm in the south of France, and the torrid zone, the mean heat of the year to be 15° and 27° cent., and the mean humidity expressed by the degrees of the hair-hygrometer, 82° and 86° I find, with M. Gay-Lussac, that the evaporation of the two zones is in the relation of 1 to 1.6, while the quantity of rain-water which the earth receives, serves as 1 to 5. We must not either forget that canals lose by evaporation only in proportion to their own surface, while they collect the waters that fall on the vast extent of surrounding lands. In the volume of water which hydraulic works require, we must distinguish between that which depends on the capacity of the

* See above, Vol. iv, p. 148.

† *Ducrès Memoires sur les quantités d'eau qu'exigent les canaux de navigation*, 1800, No. II. p. 41.

whole canal, that is, its length and section, and that which is determined by the locks, that is by the lockage water* of one sluice, or by the quantity of water which falls from the upper into the lower channel every time a vessel passes through a lock. These two volumes of water lose by evaporation and filtration; the latter, which it is very difficult to estimate, diminishes with time. The length and depth of an *oceanic canal* in the New World, must consequently have an influence on the volume of water necessary to fill it at the beginning, when the excavations are just terminated, or after having shut up the sluices, when repairs are necessary; but the quantity of water which should feed the canal annually, after making allowance for the losses caused by the filtration and evaporation, depends on the number of the *locks*, or on the relation between the quantity of the *lockage water* of one lock, and the

* In the collected *locks* we must add the *floating prison*, or the volume of water in which the ship floats, or is suspended in its passage from one lock to another. (Prony, in the works of *M. Huene de Pommeuse*, p. 23.) The consumption of water is therefore greater in going up than descending. The distribution of the falls, or the height of the successive basins, have also an influence on the waste of water in a canal, as *M. Gérard* has recently shewn. (*Annales de Physique et de Chimie*, 1823, Tom. xxiv, p. 137, and *Ducros, Memoires*, p. 39.)

activity of the navigation. The heavier the tonnage of ships, the less frequent will be their passage. I dwell on these technical considerations to remove the apprehension of wanting a sufficient volume of water to feed a canal of considerable length; and if it be meant to serve at the same time for small boats filled for inland trade, locks of less dimensions might be added to the great *locks*, in order to œconomize the waters, which has been practised on the Grand Junction canal, and was projected for some time on the Caledonian canal *.

* The capacity of the canal of Languedoc, or the *prisme de remplissage* of the whole canal, is seven millions of cubic inches, according to the calculations of M. Clauzade. The annual expence of the locks, for 960 double passages of boats, was $11\frac{1}{2}$ millions m. c. This expence, caused by locks somewhat too large for a very active given navigation, and in small boats, is consequently to the capacity of the canal as $1\frac{1}{2} : 1$. It requires besides, $3\frac{1}{2}$ millions m. c. to re-establish the waters after the shutting up as far as Fresquel, and that quantity of water is furnished in 9 days, by the upper basin, or the artificial source. (*Huerne de Pommeuse*, p. 256, 258, 265.) The product of the evaporation is estimated in the canal, the reservoirs and the trenches, during 320 days of navigation, 1,900,000 m. c. (*Ducros Mem.*, p. 41.) In comparing the Caledonian canal with that of Languedoc, I find the surface of the sections as 5 to 1; and the length of the parts dug in the canal, (excluding the navigable line of the lakes of Scotland), as $1 : 6\frac{1}{2}$. It results from these statements, that the capacities of the two canals, one of which bears flat-ribbed boats, of 100 to 120 tons, and the other

It appears somewhat probable that the province of Nicaragua will be fixed upon for the great work of the junction of the two Oceans; and in that case it will not be necessary to form a line constantly navigable. The isthmus to be passed over, is only from 5 to 6 marine leagues; there are some hills in the narrowest part, between the western bank of the lake of Nicaragua, and the gulph of Papagayo; but it is formed of uninterrupted savannahs and plains, affording an excellent road for carriages * (*camino ceratero*) between the town of Leon, and the coast of Realexo. The lake of Nicaragua is elevated above the South Sea, the height of the whole fall of the Rio San Juan, on a length of 30 leagues; and the position of this vast basin is so well known in the country, that it was considered heretofore as an invincible obstacle to

frigates of 32 guns, are almost the same; the difference of the waste of water in *lockages* arises from that of the body of water required for filling each lock; the locks being in the Caledonian canal 37 feet broad between the gates, and 160 feet long; in the canal of Languedoc 31 feet broad in the middle, 20 feet between the gates, and 127 feet long. We have seen above, that the dimensions of the canal of junction in America may be less than that of the great canal of Scotland.

* This is the great road by which merchandize is sent from Guatimala to Leon, embarking in the gulph of Fonseca or Amapala, to Conchagua, port of the *Partido* of San Miguel.

the project of a canal, from the fear of an impetuous flowing towards the west, or a diminution of the waters in the Rio San Juan, where, above the ancient Castillo de San Carlos*, are rapids, that are dangerous in time of drought. The art of engineering is sufficiently improved in our days to have no apprehension of such dangers. The lake of Nicaragua may serve as an upper basin, like the lake Oich in the Caledonian canal, and regulating sluices will furnish only as much water for the canal as it requires. The small difference of level between the Atlantic and the Pacific Oceans, depends, as I have said elsewhere†, only on the unequal height of the tides. The same difference is observed between the two seas that are joined by the great canal of Scotland; and if it were six toises, and constant like that of the Mediterra-

* This small fort, taken by the English in 1665, is vulgarly called El Castillo del Rio San Juan. It is placed, according to Mr. Juarros, at 10 leagues distance from the eastern extremity of the laguna de Nicaragua. Another small fort was constructed in 1671, on a rock at the mouth of the river. It bears the name of *Presidio del Rio de San Juan*. Even in the 16th century, the *Desaguadero de las Lagunas*, had fixed the attention of the Spanish government, who ordered Diego Lopez Salcedo to found the town of Nueva Jaen, near the left bank of the *Desaguadero*, or Rio San Juan; but it was soon abandoned, like the town of Brussels (*Bruselas*), near the gulph of Nicoya.

† Political Essay on New Spain, Vol. i. p. 32.

nean, and the Red Sea*, it would not less favor the establishment of an oceanic junction. The winds blow with sufficient force on the lake of Nicaragua, to render it unnecessary to tow the ships which pass from one sea to the other, by means of steam-boats; but the employment of the moving power of steam would be of the greatest utility in the passage from Rialexo and Panama to Guayaquil†, where, during the months of August, September, and October, calms alternate with winds that blow in a contrary direction.

In stating my ideas on the junction of the two seas, I have calculated only on the most simple means, for the execution of so vast a

* Even the ancients surmounted the difficulties of the difference of the level between the Red Sea and the pelusiatic branch of the Nile, although they were ignorant of locks, and only knew at the utmost, how to stop up the *euripes* with small beams.

† From 14 to 15 feet broad. According to the project of M. Laurent, the subterranean canal would have been, without interruption, 7000 toises (nearly three leagues) long, 21 feet broad, and 24 feet high. Its length would have surpassed by one sixth that of the famous gallery of mines of Clausthal (the George Stollen), at Harz. In order to shew what men can achieve in this kind of subterranean labor, I shall again mention the two great draining galleries of the district of the mines of Freiberg in Saxony, one of 29,504 toises, and the other 32,433. If the latter were pierced in a straight direction, it would pass over a space nearly double the breadth of the Pas-de-Calais.

project. Steam-engines for feeding the basins of partition, subterraneous tunnels, as they were proposed in the mountainous part of the isthmus of Panama, and like those of the canal of Saint Quentin, which has one of 2900 toises in length *, belong preferably to inland lines of navigation. It is sufficient for me to have shewn the practicability of an oceanic canal in central America; the estimate of the expence of its construction, of the labor of clearing the ground, and forming banks, locks, basins, and feeding trenches, must depend on the choice of the localities. The Caledonian canal, the most admirable work hitherto executed, cost nearly 3,900,000 piastres, which is 2,700,000 piastres less than the canal of Languedoc †, reducing the mark of silver to the present currency of money. The sketch of the general expence of the works of the canal of Suez, projected by M. Le Pere at the period of the expedition of Buonaparte to Egypt, amounted to 5 or 6 millions of piastres, of which a third would have belonged to the subsidiary canals of Cairo and Alexandria. The isthmus of Suez, reckoning that part which has never been

* *Huerne de Pommeuse*, p. 112.

† L. c. p. 308. The keeping of this canal, from 1686 to 1791, has cost besides, the sum of 23 millions of francs, (*Andreossy*), *Deber. du Canal du Midi*, p. 289).

reached by the tides, at 59,000 toises, (more than 20 marine leagues) of breadth, and the projected canal with four locks *, might receive vessels during several months of the year (which the risings of the Nile last), drawing from 12 to 15 feet of water. Now, in supposing that the canal for joining the seas in the New World, were to occasion an equal expence with those of Languedoc, the Highlands of Scotland, and Suez, I do not believe that this consideration would retard the execution of so great a work. The New World already furnishes examples of works no less considerable. The state of New York alone, has, in the space of six years, caused a canal to be dug between the lake Erie and the river Hudson, more than an hundred leagues long, of which the expence was estimated at nearly 5 millions of piastres †, in a report ad-

* *Description de l'Egypt (Etat moderne)*, 1808, Tom. i, 50, 60, 81, 111. The ancient canal from the Red Sea to the Nile, (*Canal des Rois*), navigable, if not under the Ptolemies, at least under the Khalifs, was only a derivation of the pelusiac branch, near Bubaste; it had a developement of 25 leagues. Its depth was sufficient for ships of great burthen, and that could navigate on the sea; it appears to have been at least from 12 to 15 feet.

† *Warden. Description of the United States*, Vol. ii. p. 197. *Morse, Modern. Geogr.* 1823, p. 122. This canal, 294,590 toises long, is only 4 feet deep, ($\frac{2}{3}$ of that of Languedoc, of which the length is 123,730 toises.) The lake Erie is 88 times above the mean waters of the river Hudson. The

dressed to the provincial legislature. When we consider in one view the gigantic works, little indeed to be praised, which have been executed within two centuries, for diminishing the waters of the lakes in the valley of Mexico, we conceive that with the same labor, the isthmus of Nicaragua and Huasacualco might have been cut, perhaps even that of Panama, between Gorgona (on the Rio Chagre), and the

boats first descend uniformly, by 25 locks, from Buffalo on the lake Erie, to Montezuma, on the river Seneca (passing by Palmyra and Lyon on a length 166 English miles), 30 toises of perpendicular fall; they then ascend 8 toises from Montezuma to Rome, on the Mohawk, for 77 miles, and finally, descend again 66 toises without discontinuing, by means of 46 locks, on a length of 113 miles, from Rome to Albany, on the river Hudson, passing by Utica. This latter descent is consequently 9 toises less than that made by the boats of the basin of partition of the canal of Languedoc in the Mediterranean. I shall again mention on this occasion, the *maximum* of the slope which I went up on a *natural navigable line*, in the bed of one of the greatest rivers of South America, destitute of cataracts and rapids. You go by rowing on the Rio Magdalena, from Carthagena to Honde, after having vanquished 135 toises of fall, which is one half more than the fall of the lake Erie to the river Hudson, and by the Magdalena, a navigable line, one third longer. In reflecting on the small slope of the Rio Magdalena de Morales at its mouth, we may conceive that without locks, a boat may proceed, by a natural navigable line, 80 marine leagues, on a table-land of 100 toises, which will give 44 of fall by 1000 toises of current.

coast of the South Sea. In the year 1607, a subterraneous canal was dug 3400 toises long, and 12 feet high, on the north of Mexico, on the other side of the hill of Nochistongo. The viceroy, Marquis of Solinas, passed along half its length on horseback. The open trench (*tajo de Huehuetoca*) which now leads the waters out of the valley, is 10,600 toises long, of which a considerable part is dug in a moveable earth; it has 140 and 180 feet of perpendicular depth, and, towards the upper part, is from 250 to 330 feet broad. The expence of these hydraulic works* of the *Desague* of Mexico, amounted, from the year 1607, to the time when I visited them, in January, 1804, to the sum of 6,200,000 piastres. It is little to be apprehended that sufficient money would not be collected for opening an oceanic canal, when we recollect that the family of the Count de la Valenciana alone, had the resolution to dig four shafts † at Guanaxuato, which cost altogether more than 2,200,000 piastres. Even supposing that during a certain number of years, the annual expence

* I have given a detailed account of those works, from official manuscript documents, in my Political Essay, vol. ii, 110, &c.

† *Tiro Viejo*, *Santo Christo de Burgos*, *Tiro de Guadalupe*, and *Tiro general*, their depth is 697, 460, 1061 and 1581 feet, (ancient French measure). See Political Essay, vol. iii, p. 196.

of the cut of the isthmus would amount to seven or eight hundred thousand piastres, that sum would be supported either by the undertakers or by the different states of America, of which the trade would derive inappreciable advantages from the opening of a new way towards Peru, the western coast of Quito, Guatemala, Mexico, Nutka, or the fur-coast, and to China.

With respect to the mode of execution, on which I have been recently consulted by well-informed persons belonging to the new governments of Equinoxial America, I believe that a joint stock association can only be formed when the practicability of an oceanic canal capable of receiving vessels of three or four hundred tons, between the latitudes 7° and 18° , has been proved, and the ground fixed upon and recognised. I shall abstain from discussing the question whether this ground "should form a separate republic by the name of *Junctiana*, dependant on the confederation of the United States," as it has been recently proposed in England, by a man whose intentions are always the most praiseworthy and disinterested. But whatever government may claim the soil on which the great junction canal of the Ocean shall be established, the benefit of this hydraulic work ought to belong to every nation of both worlds who shall have contributed to its execution by taking shares. The local governments

of Spanish America can order surveys to be made on the spot, the levelling of the ridge of partition, the measure of the distances, the soundings of the lakes and rivers to be crossed, and the estimate of the springs and rain-waters proper to feed the upper basin. These previous labors will require but a small expence, but must be executed according to a uniform plan, at the isthmuses of Tehuantepec or Goazacoalcos, Nicaragua, Panama, Cupica or Darien, and Raspadura or Choco. When the plans and profiles of these five territories are placed before the public, the persuasion of the possibility of an oceanic junction will become more general in both continents, and will facilitate the formation of a joint-stock company. A free discussion will shew clearly the advantages and disadvantages of each locality, and will soon lead to the fixing on two, or perhaps, on one sole point. The junction company will then submit the local circumstances to a second and more rigid examination; the expence will be estimated, and the execution of this important work confided to engineers who have practically engaged in executing similar works in Europe.

As there seems to be no doubt that in case of the impracticability of an *oceanic canal*, *canals of small section* might be dug in some of the five points we have named, to the great profit of the share-holders, it would perhaps be advan-

tageous to make the first survey at the expence of an association. A ship might transport the engineers and their instruments successively to the mouth of the Atrato, Rio Chagre, the bay of Mandinga, Rio San Juan, the lake of Nicaragua, and the isthmus of Huasacualco, or Tehuantepec. The facility of the operations, and the appreciation of the advantages of the different spots of which the comparison is to be made, would gain in celerity by this mode of a more uniform levelling; and *the association of the first survey*, after having fixed on the spot to be preferred, and the magnitude of the work, according to the tonnage of the ships or boats to be employed, would make an appeal to the public to augment the fund, and constitute an *association of execution*, either, as we have reason to hope, for a *canal of oceanic navigation*, or for canals or *lines of small navigation*. In adopting the mode of execution which I have just stated, all that prudence prescribes would be complied with in an affair that interests the commerce of both worlds. The *junction company* would find funds from governments and enlightened citizens, who, insensible to the allurements of gain, and yielding to noble impulses, would be proud of the idea of having contributed to a work worthy of modern civilization. It is also well to remember in this place, that the attraction of gain, the funda-

mental basis of all financial speculations, is not illusory in the enterprize for which I warmly plead. The dividends of the companies in England who have obtained the grant of opening canals, prove the utility of these enterprizes, even for the share-holders. The tax of tonnage in a canal of junction of the seas, may be so much more considerable as the ships which profit from the new passage in going to the fishery of Lima, Cachelot, or to the north-west coast of America, and thence to Canton, would considerably shorten their way, and avoid the high southern latitudes, dangerous in the bad seasons. The activity of the passage would augment in proportion as traders became more familiarized with the new direction from one ocean to the other. Even if the dividends were not sufficiently considerable, and the capitals placed in this enterprize did not bear the interest offered for the numerous loans made by governments, from the coast of the Mosquito Indians, to the last confines of Europe, it would be the policy of the great states of Spanish America, to give this enterprize their support; since it would be forgetting all that experience and political economy have taught for ages, to restrain the utility of canals and high roads, to the duties paid by the transport of merchandize, and to count for nothing the general in-

fluence exerted on industry and national prosperity *.

When we study attentively the history of the commerce of nations, we observe that the direction of the communications with India has not been changed solely according to the progress of geographical knowledge, or the improvement of the art of navigation, but that the change of the seat of civilization in the world has also powerfully contributed to this effect. From the time of the Phenicians to that of the British empire, the activity of commerce has been carried progressively from east to west; from the eastern coast of the Mediterranean to the western extremity of Europe. If this change continues moving towards the west, which every thing leads us to presume, the question on the preference given to the way to India by the southern extremity of Africa, will no longer be such as it now is. The canal of Nicaragua affords additional advantages to ships going from the mouth of the Mississippi, beyond what it promises to those which take in their lading on the banks of the Thames. In comparing the

* It is with respect to this benevolent influence that the works, far too expensive, of the canal of Languedoc must be appreciated, which cost 33 millions of franks, and produces annually, on a bare revenue of $1\frac{1}{2}$ millions, only 800,000 franks, scarcely $2\frac{1}{2}$ per cent. on the capital. Such is also the net produce of the Canal du Centre.

different routes round the Cape of Good Hope, round Cape Horn, or across a cut of the isthmus of central America, we must carefully distinguish between the objects of trade, and the nations engaged in it. The problem respecting the way presents itself in a manner altogether different to an English merchant, and to an Anglo-American ; as the problem regarding Chili, must be differently solved by those who trade directly with India and China, or those whose speculations are directed either towards northern Peru and the western coast of Guatemala and Mexico, towards China, after having visited the north-west coast of America, or towards the fishery of Cachelot in the Pacific Ocean. These three latter objects of the navigation of the nations of Europe and of the United States, would be the most indubitably benefited by the cutting of an American isthmus. From Boston to Nootka *, the antient centre of the fur-trade in otter skins, on the north-west coast of America, across the projected canal of Nicaragua, will be 2100 marine leagues ; the same voyage is 5,200 leagues, if made, as it has been hitherto,

* In these estimates of distance, I have supposed, conjointly with M. Beautemps Beaupré (engineer in chief of the royal marine), the way to be nearly straight ; this was sufficient to obtain comparative numbers. If itinerary distances are desired, we must augment the passages according to the contrariety of winds and currents, one-third or one-seventh.

by going round Cape Horn. These distances are from 3000 to 5000 leagues for a vessel going from London. From these statements, there results a shortening for the Americans of the United States of 3,100 leagues; and for the English of 2000 leagues; without including the chance of contrary winds, and the dangers of a navigation so different in the two ways which we are contrasting. The comparison is much less favourable across central America, with respect to space and time, for a direct trade with India and China. From London to Canton, going round the Cape of Good Hope, and passing the equator twice, is usually a voyage of 4,400 leagues; from Boston to Canton, 4,500; if the canal of Nicaragua were dug, the length of way would be 4,800, and 4,200 marine leagues*. Now, in the present improved state of navigation, the ordinary duration of a voyage from the United States, or from England, to China, round the extremity of Africa, is from 100 to 130 days†. In founding the calculations on the analogy of the voyages from Boston and Liverpool to the coast of the Mosquito Indians,

* It is 5,800 leagues from London to Canton, by Cape Horn; 1400 leagues more than by the Cape of Good Hope. From Boston to Canton by Cape Horn, is 5000 leagues.

† Some rare examples of 98 days have been known at Boston. *Warden, Description of the United States*, vol. v, p. 596.

and from Acapulco to Manilla*, we find from 105 to 115 days for the voyage from the United States, or from England to Canton, in remaining in the northern hemisphere, without once cutting the equator; that is, in taking advantage of the canal of Nicaragua, and the constancy of the trade-winds in the calmest part of the Pacific Ocean†. The difference of time would therefore scarcely be a sixth; vessels could not return by the same way, but in going the navigation would be safer at all seasons. A

* The Galleon takes from 40 to 60 days. See my *Pol. Essay*, vol. iv, p. 71; and *Tuckey, Maritime Geogr.* vol. iii. p. 497.

† In these estimates of time, the employment of the power of steam has not been calculated. The French engineers who made an estimate of the expence of the canal of Suez, admit, in their parallel between the navigation from the coast of France to India, across the projected canal, and the passage round the Cape of Good Hope, that by the former way, half the distance is gained, and $\frac{1}{3}$ or $\frac{1}{4}$ of time. *Descript. de l'Egypte, (Etat. moderne)*, tom. i, p. 111. It were to be wished that the *mean duration* of the passage from London to Calcutta and Canton, and from Liverpool to Buenos Ayres and Lima, (and *vice versa*), were calculated with precision, taking a sufficient number of years and ships to make the influence of seasons, winds, currents, the construction of vessels, and the errors of piloting, disappear in the total average. The duration of passages is one of the most important elements of the movement of commercial nations, that vital movement which augments from age to age with the improvement of the art of navigation.

nation possessing fine settlements at the extremity of Africa and the Isle de France, would, I believe, in general prefer the passage from west to east. The principal and real object of the opening of the isthmus is the prompt communication with the western coast* of America,

* We must except, however, the coast of Peru, south of Lima, and that of Chili, which it is extremely difficult to ascend from north to south. The passage would be quicker from Europe to Valparaiso and Africa, by Cape Horn, than by the canal of Nicaragua. The canal will be advantageous for the trade of the western coast south of Lima only when the coasting is made by steam-boats. The trade of North America with China, in its present state, is carried on by the three following means: 1st, The vessels of the United States, loaded with piastres, go directly from New York or Boston by the Cape of Good Hope to Canton, where they purchase tea, nankeen, silks, china, &c. and return by the same route; 2dly, the vessels that go round Cape Horn, either for the seal and sea-horse fishery in the South Sea, or to visit the north-west coast of America; if they have not obtained a sufficient quantity of furs, they take sandal-wood, or ebony in Polynesia, carry those productions to Canton, and go back by the Cape of Good Hope; 3dly, other vessels carry on a smuggling trade for several years, visiting successively Madeira, the Cape of Good Hope, the Isle of France, or New South Wales, some ports of South America, and the islands of the Pacific Ocean; in going, they sometimes double the Cape of Good Hope, sometimes Cape Horn; but as they constantly touch at Canton at the end of this long voyage, they return to the United States by the southern extremity of Africa. The opening of the isthmus will have a powerful influence on the two latter passages, which we have just pointed out.

the voyage from the Havannah, and the United States to Manilla, the expeditions made from England and the Massachusets to the fur-coast (north-west coast) or to the islands of the Pacific Ocean, to visit afterwards the markets of Canton and Macao.

I shall add to these commercial considerations some political views on the effects which the projected junction of the seas may produce. Such is the state of modern civilization, that the trade of the world can undergo no great changes that are not felt in the organization of society. If the project of cutting the isthmus that joins the two Americas, should succeed, Eastern Asia, at present insulated and secure from attack, will inevitably enter into more intimate connections with the nations of European race which inhabit the shores of the Atlantic. It may be said, that that neck of land against which the equinoxial current breaks, has been for ages the bulwark of the independence of China and Japan. In penetrating farther into futurity, imagination dwells upon the conflict between powerful nations, eager to obtain exclusive advantages from the way opened to the commerce of the two worlds. I confess I am not secured from that apprehension either by my confidence in the moderation of monarchical or of republican governments, or by the hope, somewhat shaken, of the progress

of knowledge, and the just appreciation of human interests. If I abstain from discussing political events that are so distant, it is to avoid flattering my reader with ideas of the free enjoyment of what yet exists only in the wishes of some men interested in the public good.

The lake of Nicaragua and the Rio San Juan do not, as it has been affirmed in some ancient works, belong to the territory of New Grenada; the lake is separated from the Columbian territory of Veragua by Costa-Rica, the most southern province of the ancient kingdom of Guatemala. Placed in a country thinly peopled, especially towards the east, and almost on the confines of the two independent states of central, and southern America, the great works which must be established for the junction of the two seas, will have no military defence but from Portobello and Carthagena, two fortresses to the windward of Castillo de San Juan de Nicaragua. There is indeed a road by land, from Guatemala to Léon, but the distance is more than 135 leagues. In the present state of things, it is less the strong places than the misery of the country, its want of culture, and the force of vegetation, which from Darien to the 10th and 11th degree of north latitude, have rendered unavailing the invasions of an enemy who disembarks suddenly on the eastern coast. In treating this important question, I cannot rest

upon a more solid testimony than that of general Don Josè de Espeleta, who was viceroy of New-Grenada till 1796. This experienced officer, in a manuscript memoir, which is addressed to his successor, the viceroy Don Pedro de Mendinueta *, thus expresses himself on the defence of the isthmus of Panama: "Your Excellency is informed that the king has caused his vast possessions in America to be visited by the Brigadier Cramer. That celebrated engineer has calculated the dangers to which we are still exposed, and indicated the fortifications which must be erected for defence. The isthmus of Panama is of the highest military importance, of which your Excellency ought not to lose sight for one instant. Its importance is founded on its geographical configuration, and its proximity to the South Sea; it presents three points of defence, Portobello, and the small fort of San Lorenzo de Chagre towards the north, and the town of Panama towards the south. The heights which command Portobello render it impossible to fortify to any good purpose that poor and ill-peopled town; the batteries of San Fernando, Santiago, and San Geronimo, appear to me sufficient for the defence of the port. The small fort of Chagre, at the mouth of the

* *Relacion del Gobierno, Parte quarta, Cap. III., fol. 118, 122, 123 (manuscript).*

river of that name, is in my opinion, the principal point of the isthmus, in the most natural supposition that the attack comes from the north; but neither the taking of Portobello nor the fort of San Lorenzo de Chagre, would determine the possession of the isthmus of Panama. The real defence of that country consists in the difficulty which every considerable expedition will find in penetrating into the interior. On the southern coast, which is entirely unpeopled, this difficulty already exists for two or three insulated travellers."

After having discussed the extent of the surface, the population, the productions, and the trade of the United-Provinces of Venezuela, in their present state as well as in their more or less distant increase, it remains for me to speak of the finances, or the revenue of the state. This object is of such political importance, that it comprehends one of the first conditions of the existence of a government; but after long civil dissensions, after a war of thirteen years, during which agriculture has retrograded, commercial relations have been shackled, and the principal sources of public revenue dried up, we can only describe a state of things altogether transitory, and little conformable to the natural riches of the country. In order to take a more certain point of departure for judging of the state of things when confidence and tran-

quillity shall be re-established, we must go back again to the period which preceded the revolution. The annual average of the clear receipts of the whole contributions, from 1793 to 1796, without comprehending the farm of tobacco, was 1,426,700 piastres. In adding to this, 586,300 piastres as the net product of the farm (the average of the same period), we find the revenue of the *Capitania general de Caracas*, deducting the expence of collecting, to be 2,013,000 piastres. This revenue has gone on diminishing, on account of the difficulties of maritime trade, in the last years of the 18th, and the first years of the 19th century; but from 1807 to 1810 it rose to more than 2,500,000 piastres (of which 1,200,000 piastres arose from the customs, 700,000 from the farm of tobacco, and 400,000 from the alcavala of land and sea). All these receipts were absorbed by the expence of the administration; sometimes a surplus of 200,000 piastres was poured into the treasury of Madrid, but these examples were extremely rare. Since Caraccas has no longer received the *situado* of New-Spain, resources have from time to time been drawn from the no less impoverished bank of Santa-Fe. The gross revenue of all the provinces which now form the republic of Columbia, amounted, according to my researches, at the moment of the revolution,

to a *maximum* of $6\frac{1}{2}$ millions of piastres*, of which the government of the mother-country never drew more than a twelfth. I have shewn, in my Political Essay, that the Spanish colonies in America, at the period of the greatest activity of commerce and the mines, *had a gross revenue of thirty-six millions of piastres; that the internal administration of the colonies absorbed nearly twenty-nine, and that only from seven to eight millions of piastres flowed into the royal treasury of Madrid.* From these statements, founded on official documents, and of the exactness of which no doubt has been entertained during fifteen years, we are surprised to find that in grave discussions on political economy, the financial embarrassments of the mother-country are still attributed so often to its separation from its colonies. The duties on importation and exportation are, throughout America, the principal source of public revenue; that source is become progressively more abundant since the court has deprived the company of Guipuzcoa of the monopoly of trade with Venezuela; a company in which, according to the singular expression of a *royal cedula*, “every body may take part without derogating from

* Don Jose Maria del Castillo, in his report to the Congress of Bogota (5th May, 1823) estimates *las rentas ordinarias* at present, at only 5 millions of piastres.

nobility, and *without losing honor or reputation.*" If we reflect that of late years the custom-house of the Havannah only, has collected more than three millions of piastres; and if we consider at the same time the extent of the territory, and the agricultural wealth of Venezuela, we cannot doubt of the progressive increase of the public revenue in that fine part of the world; but the accomplishment of this hope, and every other we have announced, depends on the return of peace, and on the wisdom and stability of the institutions that are established.

I have stated in this chapter the statistical elements which I had occasion to collect in my travels, and by my uninterrupted intercourse with the Spanish-Americans. As the historian of the colonies, I have presented facts in all their simplicity; the attentive and exact study of those facts being the only means * of laying aside vague conjectures, and vain declamations. This wary manner becomes the more indispensable at a moment when we may be tempted to yield too easily to the predilections of hope, and of ancient affections. Dawning societies possess something of the charm of youth; they have its glowing sentiments, its ingenuous confidence, and even its credulity; they offer a

* *Recherches statistiques sur la ville de Paris, 1823, Introd. p. 1 et 5.*

more powerful attraction to the imagination than the querulous temper, and distrustful austerity of old nations which seem to have worn out every thing, their happiness, their hope, and their belief in human perfectibility.

The great struggle during which Venezuela has fought for its independence, has lasted more than twelve years. That period has been fruitful, as civil commotions are for the most part, in heroism, generous actions, guilty errors and irritated passions. The sentiment of common danger has strengthened the ties between men of various races, who, spread over the steppes of Cumana, or insulated on the table-land of Cundinamarca, have a physical and moral organization as different as the climate under which they live. The mother-country has several times regained possession of some districts; but as revolutions are always renewed with more violence when the evils that produce them can no longer be remedied, these conquests have been transitory. In order to facilitate and give greater energy to the defence of this country, the governing powers have been concentrated, and a vast state has been formed from the mouth of the Oronooko to the other side of the Andes of Riobamba, and the banks of the Amazon. The *Capitania-general* of Caraccas has been united to the vice-royalty of New Grenada, from which it was only separated entirely in

1777. This union, which will be always indispensable for external safety, this centralization of powers in a country six times larger than Spain, has had political combinations for its motive. The calm progress of the new government has justified the wisdom of those motives, and the Congress will find still fewer obstacles in the execution of its beneficent projects for national industry and civilization, in proportion as it can grant more liberty to the provinces, and make them feel the advantages of institutions which they have purchased at the price of their blood. In every form of government, in republics as well as in tempered monarchies, ameliorations in order to be salutary must only be progressive. New-Andalusia, Caraccas, Cundinamarca, Popayan, and Quito, are not confederated states like Pensylvania, Virginia, and Maryland. Without *juntas*, or provincial *legislatures*, all those countries are directly subjected to the congress and government of Columbia. According to the constitutional act (art. 152), the intendants and governors of the departments and provinces are named by the president of the republic. It may be naturally supposed that such dependence has not always appeared favorable to the liberty of the communes, which tend to discuss themselves their local interests, and that it has sometimes occasioned debates which may be

termed geographical. The ancient kingdom of Quito, for instance, is connected at the same time, by the habits and language of its mountainous inhabitants, with Peru and New-Grenada. If there were a provincial *junta*, if they resorted to the congress only for the taxes that are necessary for the defence and general welfare of Columbia, the feeling of an individual political existence would render the inhabitants less interested in the choice of the spot where the central government is placed. The same reasoning applies to New-Andalusia or Guyana, which are governed by intendants named by the President. It may be said that these provinces are hitherto in a position little different from such territories of the United States as have a population below 60,000 souls. Peculiar circumstances, which cannot be justly appreciated at such a distance, have no doubt rendered great centralization necessary in the civil administration; every change would be dangerous as long as the state has external enemies; but the forms useful for defence, are not always those which, after the struggle, sufficiently favor individual liberty, and the development of public prosperity. History proves that this difficulty, when not overcome with prudence, has more than once been the rock against which the enthusiasm and the affections of nations have made shipwreck. Without breaking the

ties which should for ever unite the different parts of the Columbian territory (Venezuela, New-Grenada, and Quito), a partial life may be spread by degrees throughout this great political body, not to divide, but augment its vigor.

The powerful union of North America has long remained insulated, and without touching any states with analogous institutions. Although, as we have observed above, the progress she makes in the direction from east to west, is considerably slackened towards the right bank of the Mississippi, she will advance without interruption towards the *internal provinces* of Mexico; and will there find a European people of another race, other manners, and a different worship. Will the feeble population of those provinces, belonging to another dawning federation, resist, or will it be enveloped by the torrent of the east, and transformed into an Anglo-American state, like the inhabitants of Lower-Louisiana? The future will soon solve this problem. On the other hand, Mexico is separated from Columbia only by Guatimala, a country of extreme fertility, and which has recently assumed the denomination of the republic of Central America. The political divisions between Oaxaca and Chiapa, Costa Rica and Veragua, are not founded either on the natural limits, or the manners and languages of the

natives, but solely on the habit of dependence on the Spanish chiefs who resided at Mexico, Guatemala, or Santa-Fè de Bogota. It appears natural enough that Guatemala may one day join the isthmuses of Veragua and Panama to the isthmus of Costa-Rica ; and Quito connect New-Grenada with Peru, as la Paz, Charcas, and Potosi link with Buenos-Ayres *. The intermediate parts which we have just named, from Chiapa to the Cordilleras of Upper Peru, form the passage from one political association to another, similar to those transitory forms, by which the various groups of the organic kingdom are linked in nature. In neighbouring monarchies the provinces that touch each other present those striking demarcations which are the effect of a great centralization of power ; in confederated republics, states that are placed at the extremities of each system, are for some time in oscillation before they acquire a stable equilibrium. It would be almost indifferent to the provinces between Arkansa and the Rio del Norte, whether they send their deputies to Mexico or to Washington. If Spanish America were one day to shew more uniformly the tendency towards federalism, which the example of the United States has already excited on several points, from the contact of so many sys-

* See above, vol. vi, p. 169.

tems or groupes of states, confederations variously graduated would result. I here only touch on the relations that arise from this singular assemblage of colonies on an uninterrupted line of 1600 leagues in length. We have seen in North America, an old atlantic state divided into two, and each having a different representation. The separation of the Maine and the Massachusets, in 1820, was made in the most peaceable manner. Schisms of this kind will no doubt frequently occur in the Spanish colonies; but their moral state will, it may be feared, render such changes turbulent. When a people of European race naturally incline towards provincial and municipal independence, while the copper-colored natives have a no less decided taste for political divisions of territory, and the liberty of small communes, the best form of government is that which, without openly struggling against a national predilection, renders it the least hurtful to the general interest, and the unity of the whole body. It may be observed further, that the importance of the geographical divisions of Spanish America, founded at the same time on the relations of local position, and the habits of several centuries, have prevented the mother-country from retarding the separation of the colonies by attempting to establish Spanish princes in the New World. In order to rule such vast pos-

sessions it would have been requisite to form six or seven centres of government, and that multiplicity of centres, (vice-royalties and captaincies-general), was hostile to the establishment of new dynasties at the period when they might still have produced some salutary effect for the mother country.

Bacon * has said, in his Political Aphorisms, that "it would be happy if nations would always follow the example of time, the greatest of all innovators, but who acts calmly, and almost without being perceived." This happiness does not belong to colonies when they reach the critical period of their emancipation ; and least of all to Spanish America, engaged in the struggle at first, not to obtain its complete independence, but to escape from a foreign yoke. May the agitations of party be succeeded by a double calm ! May the germ of civil discord, disseminated during three centuries to secure the dominion of the mother country, be stifled by degrees ; and productive and commercial Europe become more persuaded, that to perpetuate the political agitations of the New World would be to impoverish itself, in diminishing the consumption of its productions, and depriving itself of a market which already amounts

* See the article of Innovations, in *Bacon's Essays civil and moral*, No. 25. (*Opera omnia*, 1730, vol. iii, p. 335.)

to more than 70 millions of piastres. The exports from Spanish America, the United States, France, and Great Britain, are at present as the numbers $1,1\frac{3}{100}$, $1\frac{40}{100}$ and $3\frac{75}{100}$ *. Many years must no doubt elapse before 17 millions of inhabitants, spread over a surface a fifth greater than the whole of Europe, will have found a stable equilibrium in governing themselves. The most critical moment is that when nations, after long

* I have shewn in another work (*Political Essay*, vol. iv, p. 129), that in 1805, making the most moderate calculations, Spanish America already stood in need of an importation of foreign merchandize to the amount of 59,000,000 piastres, a value nearly three times greater than that required by the United States, eight years after their independence had been recognized by Great Britain. To give a view of comparative numbers, I shall state the imports and exports of the two most commercial nations of the world, the English of Europe, and of America. The annual value of the imports of Great Britain, from 1821 to 1823, amounted to 30,203,000 pounds sterling; the value of the exports to 50,636,800 pounds sterling. The exports of the United States, in 1820, were 69,974,000 dollars; the imports 62,586,000 dollars. At an anterior period, from 1802 to 1804, the exports were, mean year, 68,461,000 dollars, and the imports 75,306,000 dollars; whence it results that the imports of the United States, and of Spanish America, immediately before the political agitations of the latter country, were alike considerable. It must not be forgotten, that what is imported to Spanish America, is there used, and not re-exported. The exports and imports of France in 1821, were respectively 404,764,000, and 394,442,000 francs.

servitude, find themselves suddenly at liberty to dispose of their existence for the improvement of their prosperity. The Spanish Americans, it is unceasingly repeated, are not sufficiently advanced in intellectual cultivation to be fitted for free institutions. I remember that at a period little remote, the same reasoning was applied to other nations, who were said to have made too great a progress in civilization. Experience, no doubt, proves that nations, like individuals, find ability and learning often unavailing to happiness ; but without denying the necessity of a certain mass of knowledge and popular instruction for the stability of republics or constitutional monarchies, we believe that stability to depend much less on the degree of intellectual improvement than on the strength of the national character ; on that proportion of energy and tranquillity, of ardor and patience, which maintains and perpetuates new institutions ; on the local circumstances in which a nation is placed ; and on the political relations of a country with the neighbouring states.

If all modern colonies, at the period of their emancipation, manifest a tendency more or less decided for republican forms of government, the cause of this phenomenon must not be attributed solely to a principle of imitation, which acts still more powerfully on masses of men than on individuals. It is founded principally

on the position in which a community is placed suddenly detached from a world more antiently civilized, free from every external tie, and composed of individuals who recognize no political preponderance in the same caste. The titles conferred by the mother country on a small number of families in America, had not formed what is called in Europe an aristocracy of nobility. Liberty may expire in anarchy, or by the transitory usurpation of a daring chief; but the true elements of monarchy are no where found in modern colonies: those elements were imparted to Brazil at the moment when that vast country enjoyed profound peace, while the metropolis had fallen under a foreign yoke.

In reflecting on the chain of human affairs, we may conceive how the existence of modern colonies, or rather how the discovery of a half-peopled continent, in which alone so extraordinary a development of the colonial system was possible, must have led to the revival on a great scale, of the forms of republican government. The changes which social order has undergone in our days in a considerable part of Europe, have been regarded by some celebrated writers as the tardy effect of the religious reformation at the beginning of the 16th century. We must not forget that the memorable epocha when ardent passions, and a taste for absolute dogmas, were the rocks on which European poli-

tics were shipwrecked, was the epocha also of the conquest of Mexico, Peru, and Cundinamarca; a conquest which, according to the noble expressions of the author of *l'Esprit des Lois*, leaves the mother country an immense debt to pay in order to acquit itself towards human nature. Vast provinces opened to colonists by Castillian valour, were united by the ties of a common language, manners, and worship. Thus, by a strange coincidence of events, the reign of the most powerful and absolute monarch of Europe, Charles the Fifth, prepared the struggle of the 19th century, and laid the basis of those political associations, which, though scarcely traced, astonish us by their extent, and the uniform tendency of their principles. If the emancipation of Spanish America be consolidated, as every thing hitherto leads us to hope, the Atlantic will display on its opposite shores, forms of government which are not necessarily hostile because they are different. The same institutions cannot be salutary to every nation of both worlds, and the growing prosperity of a republic is no outrage to monarchies that are governed with wisdom, and a respect for the laws and public liberty.

NOTES

TO

THE NINTH BOOK.

NOTE A.

IT being my intention to collect in this work whatever can throw light on the history of the two Americas, I shall state succinctly the results of the most recent researches on the lines of fortification, and the *tumuli* found between the *Rocky Mountains* and the chain of the Alleghanies. The fortifications chiefly occupy the space between the great lakes of Canada, the Mississippi, and the Ohio, from the 44° to the 39° of latitude. Those which advance most towards the north-east are on the Black River, one of the tributary streams of lake Ontario. Towards the west we discover scattered and inconsiderable mountains, in the county of Genesee, but they augment in number and greatness as we advance towards the banks of Cataraugus-creek ; and from that creek, they succeed without interruption, west and south-west, on a length of 50 miles. The most remarkable antient fortifications in the state of the Ohio, are : 1st, Newark (Licking County). A very regular octagon, containing an *area* of 32 acres, and connected with a circular circumvallation of 16 acres. The eight great doors of the octagon are defended by eight works placed before each opening. 2dly, Perry County. Numerous walls, not in

clay, but stone. 3dly, Marietta. Two great squares, with twelve doors; the walls of earth are 21 feet high, and 42 feet at their base. 4thly, Circleville; a square with eight doors, and eight small works for their defence, connected with a circular foot, surrounded with two walls and a moat. 5thly, Paint-Creek, at the confluence of the Scioto and the Ohio; the fortifications are partly irregular; one of them contains 62 acres. 6thly, Portsmouth, opposite Alexandria. Vast ruins, disposed on parallel lines, denote that this spot heretofore contained a numerous population. 7thly, Little Miami and Cincinnati, a wall of 7 feet high, and 6300 toises long; it goes from the Great to the Little Scioto. (*Journ. of General Clinton; Western Gazetteer*, p. 108; *Warden, Description of the United States*, Vol. iv. p. 137; *Weekly Recorder of the Ohio*, Vol. ii. No. 42, p. 324; *Med. Repos.* Vol. xv. p. 147; *New Series of the Med. Repos.* Vol. iii. p. 187; *Harris's Tour*, p. 149; *Drake's Picture of Cincinnati*, p. 204; *Mease's Geolog. account of the United States*, p. 478; *Caleb Atwater, in the Archæologia Americana, or Transactions of the American Antiquarian Society of Worcester, Massachusetts*, 1820, p. 122, 141, and 147.) All these square forts are placed as exactly to the east as the Egyptian and Mexican pyramids; when the forts have only one opening, it is directed towards the rising sun. The walls of these lines of fortification are most frequently of earth; but two miles from Chillicothe, in the state of Ohio, we find a wall constructed in stone, from 12 to 15 feet high, and from 5 to 8 feet thick, forming an inclosure of 80 acres. It is not yet precisely known how far those works extend to the west, along the course of the Missouri and the river la Plata; but they are not found on the north of the lakes Ontario, Erie and Michigan, neither do they pass the chain of the Alleghanies. Some circumvallations discovered on the east of that chain on the banks of the Chenango, near Oxford, in the state of New York, may be considered as a very remark-

able exception. We must not confound these military monuments with the mounds or *tumuli* containing thousands of skeletons of a stunted race of men scarcely five feet high. These mounds increase in numbers from the north towards the south ; the highest are near Wheeling and Grave-Creek (diam. 300 feet, height, 100 feet) ; near Saint Louis, on Cahokia-Creek (diam. 800 feet, height 100 feet) ; near new Madrid (diam. 350 feet) ; near Washington, in the state of Mississipi, and near Harrison town. Mr. Brackenridge thinks there are nearly 3000 *tumuli* from 20 to 100 feet high, between the mouth of the Ohio, the Illinois, the Missouri, and the Rio San-Francisco ; and that the number of skeletons they contain, indicate how considerable must have been the population heretofore of those countries. These monuments, considered as the places of sepulture of great communes, are most frequently situated at the confluence of rivers, and on the most favorable points for trade. The base of the *tumuli* is round or of an oval form ; they are generally of a conical form, and sometimes flattened at the summit as if intended to serve for sacrifices, or other ceremonies to be seen by a great mass of people at once. (See my *Views of the Cordilleras*, p. 35.) Some of these monuments near Point-Creek and Saint Louis, are two or three stories high, and resemble in their form the Mexican *teocallis* and the pyramids with steps, of Egypt and Western Asia. Some of the *tumuli* are constructed of earth, and some of stones (Stone-Mounds), [or Cairns] heaped together. Hatchets have been found on them, together with painted pottery, vases, and ornaments of brass, a little iron, silver in plates (near Marietta), and perhaps gold (near Chillicothe). Some of these mounds are only a few feet high, and are placed at the centre, or in the neighbourhood of the circular circumvallations ; they resemble the *cerritos hechos a mano*, which in the kingdom of Quito, near Cayambe, are called *adoratorios de los Indios antiguos* ; they were either tribunes for ha-

ranging the assembled people, or places of sacrifice ; and where they are only from 20 to 25 feet high, they may be considered as observatories erected to discover the movements of a neighbouring enemy. (*Arch. Amer.* Vol. i. p. 185, 189, 246, 210, 168, 178.) The great *tumuli*, from 80 to 100 feet high, are most frequently insulated, and sometimes seem to be of the same age as the fortifications to which they are linked. The latter merit particular attention ; I know no where any thing that resembles them, either in South America, or the ancient continent. The regularity of the polygon and circular forms, and the small works intended to cover the doors of the building, are above all remarkable. We know not whether they were inclosures of property, walls of defence against enemies, (*Relat. Histor.* Tom. i. 85), or intrenched camps, as in central Asia. The custom of separating the different quarters of a town by circumvallations, is observed alike in the ancient Tenochteitlan, and the Peruvian town of Chimú, the ruins of which I examined, between Truxillo and the coast of the South Sea. (*Political Essay*, Vol. ii. p. 8). The *tumuli* are less characteristic constructions, and may have belonged to nations who had no communication with one another ; they cover both Americas, the north of Asia, and the whole east of Europe ; and it is said, are still constructed by the Omáw-haws of the river Plata. The skulls contained in the *tumuli* of the United States, furnish means of recognizing almost with certainty, to what degree the race of men by whom they were raised, differed from the Indians who now inhabit the same countries. M. Mitchell believes that the skeletons of the caverns of Kentucky and Tennessee “ belong to the Malays, who came by the Pacific Ocean to the western coast of America, and were destroyed by the ancestors of the present Indians, and who were of Tartar race (Mongul).” With respect to the *tumuli* and the fortifications, the same learned writer supposes, with Mr. De Witt Clinton, that

those monuments are the works of Scandinavian nations, who, from the 11th to the 14th century visited the coast of Greenland, Newfoundland, or Vinland, or Drogeo, and a part of the continent of North America. (*View of the Cordilleras*, Vol. i. p. 85.) If this hypothesis be founded, the skulls found in the *tumuli*, and of which Mr. Atwater, at Circleville, possesses so great a number, ought to belong not to the American, Mongul, or Malay race, but to a race vulgarly called Caucasian. The engraving of those skulls, in the *Memoirs of the Society of Massachusetts*, is too imperfect to decide an historical question so well worthy to occupy the osteologists of both continents. Let us hope that the learned men who now honor the United States, will hasten to convey the skeletons of the *tumuli*, and those of the caverns, to Europe, that they may be compared together, and with the present inhabitants of native race, as well as with the individuals of Malay, Mongul, and Caucasian race; found in the great collections of MM. Cuvier, Sommering, and Blumenbach. In order to advance in these kinds of researches, so important towards the history of the human species, it appears to me that the attention should be directed to three principal points; namely, 1st. To the osteologic comparisons, which cannot be made successfully from drawings, descriptions, or the mere testimony of travellers. The skulls of the ancient inhabitants (of that race believed to be extinct), must be compared with the skulls of the different varieties of the human race; and we must not forget in this comparison, that among the present natives of the new continent some tribes furnish very remarkable varieties of conformation. It may suffice to cite the Tchougaze Esquimaux in the north, whose children are born white; and more to the south, the Chepewyans, the Panis (Apaches) and the Sioux; three nations, which from their traditions and their aspect, Mackenzie, Pike and Lewis, consider as having come from Asia, and being strongly mungolized. (*Mackenzie*, See

Vol. i. p. 275, Vol. iii. 342; *Pike*, p. 274; *Lewis and Clarke*, p. 146); 2dly. To the relations of construction or of geographical position observed between the monuments of the United States, the banks of the Ohio, and the Missouri, and the Mexican monuments of Gila and Nabajoa. The country between the 33° and 41° of latitude, parallel to the mouth of the Arkansas and the Missouri, is considered by the Azteque historians, as the ancient dwelling of the civilized nations of Anahuac. These historians place the first station of the Mexicans, in the course of their migration from north to south, on the banks of the lakes (fabulous?) of Teguayo, and Timpanogos; the second station is marked by the ruins of the *Casas-Grandes* of Rio Gila, which the fathers Garces and Font have described in detail (*Political Essay*, II. Vol. i. p. 254, and in my Mexican Atlas, maps 1 and 2). These edifices, which occupy a square league, are placed exactly at the four cardinal points, and, like the ancient Kara-Korum, the capital of the Monguls, are surrounded with lines of fortification. The vestiges of great towers are recognized, which are connected by walls built of clay. (This system of defence recalls to mind the military monuments of the United-States; there is, however, a distance of more than 600 leagues from the Casas-Grandes on the Rio Gila to the ancient fortifications of Black-River, a tributary stream of the lake Ontario; 3dly. To the traditions and moral state of the nations which inhabit the country between the right bank of the Mississippi, and the coast of the Pacific Ocean. From Upper Louisiana towards the Rio Columbia, we observe civilization augmenting progressively on the west of the Rocky-Mountains, which are joined by la Sierra Verde and la Sierra de las Grallas, to the Mexican Andes of Anahuac. (*Brackenbridge, Views of Louisiana*, p. 173, *M'Culloch's Researches on America*, p. 203.) The fathers of the seraphic college of Queretaro, found in the year 1773, in the Moqui, traversed by the Rio Yuquesila, a well-peopled

Indian village, with two public squares, houses with several stories, as in the Casas Grandes, and streets in parallel lines. The natives of these countries, near which the *first station* of the Mexican nations is placed, have long beards, like the Ainos (inhabitants of Tarakai) of eastern Asia. These are the Yabipais, whose language differs essentially from that of the Asteques. This analogy of construction among the present and the ancient inhabitants, whatever may be the superiority of the latter in their civilization, is a very curious phenomenon. I know how little confidence can be placed in the narratives of Fray Marcos de Niza ; but it cannot be doubted that in the middle of the 16th century, a small centre of civilization was still preserved in the regions situated on the north of New Mexico, at Cibora, and at Quivira. When well-informed travellers shall one day have explored the plains between the Rio Colorado and the Rio Colombia, those plains which the ecclesiastic Escalante went partly over in 1777, it will be important to compare the present state of the country, and above all the names of places, with the detailed journals we possess of the expedition of Francisco Vasquez de Cornado (1540). The Spanish historians give strange variations to the names of places and men in this Mexican *Dorado* ; (Harac, Tinxex, Cicuic, Acuc, Huex, Tutonteac, and the name of that king Tatarax, *Señor de las siete ciudades*, who was made a kind of Prester-John ; “ Hombre barbudo, que rezava en oras, que adorava una cruz de oro, y una imagen de muger, Señora del cielo.” (Gomara, *Hist. de las Indias*, 1553, fol. cxvii ; Herera *Decad.* vi, p. 157, 204 ; Laet, p. 297—304 ; *Viaje al Estrecho de Fuca*, p. 27 ; *Political Essay*, ii. 277 ; *View of the Cordilleras and Monuments*, Vol. i, p. 307, 318 ; *Personal Narrative*, Vol. v. p. 844.) The *Conquistadores* placed Cibora, no doubt vaguely (according to the name of the bisons, *cibolas*, or cows with humps, and long hair, *vacas carcobadas*), in lat. 30° 30' ; Quivira, in latitude 40°.

In reading the first Spanish historians with attention, it would appear that the two countries are situated west of the Rocky Mountains ; but Cornado states clearly, that in going to the north, the rivers are found to flow, as far as the Cibola, towards the west ; and beyond Cibola, as far as Quivira, towards the east. There is no question however, in any of these expeditions to the north, of a passage across the mountains ; Quivira is described as an immense plain, where it is difficult to mark the way. Whatever opinion may be formed of the abrupt lowering of the mountains, north of New Mexico, it is difficult to figure, between the Rocky Mountains and the Sierra Verde, a point of partition of the waters, *divortia aquarum*, situated in a plain. Francisco Vasquez de Cornado, in his letter to the viceroy, complains of the falsehoods of the monk Marcos de Niza ; and to justify his return, paints the country through which he had passed, as poor and savage : he is, however, so much struck with the grandeur of the edifices at Cibola and Quivira, several stories high, built of stone and clay, that he doubts if the natives, who he says are intelligent but little industrious, could have constructed them. This testimony of a man of veracity is well worthy of attention. Does it indicate a people relapsed into barbarism, and who had preserved some knowledge of the mechanic arts ? Every house in Quivira having a flat roof, or a terrace (*azotea*), Cornado calls the whole country “ la tierra de las azoteas.” Terraces of the same kind were found in 1773, by Father Garces, in the villages of the present Indians of Moqui. Did the nations of the Mexican race, in their migrations to the south, send colonies towards the east, or do the monuments of the United States pertain to the autochthone nations ? Perhaps we must admit in North America, as in the ancient world, the simultaneous existence of several centres of civilization, of which the mutual relations are not known in history. The very civilized nations of New-Spain, the Tol-

teques, the Chichimeques, and the Azteques, pretended to have issued successively, from the 6th to the 12th century, from three neighbouring countries situated towards the north, and called Huehuetlapallan or Tlalpallan, Amaquemecan, and Aztlan or Teo-Alcohuacan. These nations spoke the same language, they had the same cosmogonic fables, the same propensity for the sacerdotal congregations, the same hieroglyphic paintings, the same divisions of time, the same taste (Chinese and Japanese) for noting and registering every thing. The names given by them to the towns built in the country of Anahuac, were those of the towns they had abandoned in their ancient country. The civilization on the Mexican table land was regarded by the inhabitants themselves as the copy of something which had existed elsewhere, as the reflection of the primitive civilization of Aztlan. Where, it may be asked, must be placed that parent land of the colonies of Anahuac, that *officina gentium*, which during five centuries, sends nations towards the south, who understand each other without difficulty, and recognize each other for relations? Asia, north of Amour, where it is nearest America, is a barbarous country; and, in supposing (which is geographically possible) a migration of southern Asiatics by Japan, Tarakay (Tchoka), the Kurile and the Aleutian isles, from southwest towards the north-east, (from 40° to 55° of latitude), how can it be believed that in so long a migration, on a way so easily intercepted, the remembrance of the institutions of the parent country could have been preserved with so much force and clearness! The cosmogonic fables, the pyramidal constructions, the system of the calendar, the animals of the tropics found in the catasterism of days, the convents and congregations of priests, the taste for statistic enumerations, the annals of the empire held in the most scrupulous order, lead us towards oriental Asia; while the lively remembrances of which we have just spoken, and the peculiar

physiognomy which Mexican civilization presents, in so many other respects, seem to indicate the antique existence of an empire in the north of America, between the 36° and 42° of latitude. We cannot reflect on the military monuments of the United States, without recollecting the first country of the civilized nations of Mexico. It is in rising to more general historical considerations, in examining with more care than has been hitherto done, the languages, and the osteologic conformation of different tribes, in exploring the immense country bounded by the Alleghanies, and the coast of the western ocean, that means will be obtained of throwing light upon a problem so worthy of exercising the sagacity of historians. In these researches there can be no question either respecting the first inhabitants of America (real history does not go back so far), or of a very advanced civilization, superior, for instance, to that of so many nations of Tartar or Mongul race in central Asia; nor, finally, respecting the fortuitous analogy of some sounds, some syllables that are again found, with significations altogether different, in the Tschoude, Indo-pelagic, Iberian or Basque, and Welsh or Celtic tongues. (*Wilhelm von Humboldt, über die Urbewohner Hispaniens*, p. 95.) It is from vague and unphilosophical views that Indians have occasionally been believed to be discovered who speak Irish, Bas Breton, or the Celtic of Scotland. The fable of Welsh *Indians*, having preserved the Welsh, or Celtic language, is of very old date. In the time of Sir Walter Raleigh, a confused report was spread over England, that on the coast of Virginia the Welsh salutation had been heard; *hao, houi, iach*. Owen Chapelain relates, that in 1669, by pronouncing some Celtic words, he saved himself from the hands of the Indians of Tuscorora, by whom he was on the point of being *scalped*! The same thing, it is pretended, happened to Benjamin Beatty, in going from Virginia to Carolina. This Beatty asserts that he found a whole Welsh tribe, who preserved the tradition of the

voyage of Madoc-ap-Owen, which took place in 1170! John Filson, in his history of Kentucky, has revived these tales of the first travellers; according to him, Captain Abraham Chaplain saw Indians arrive at the post of Kaskasky, and converse in the Welsh language with some soldiers who were natives of Wales. He also believes, that "far off, to the west, on the banks of the Missouri, there exists a tribe which, besides the Celtic language, has also preserved some rites of the Christian religion." (*Hist. of Kent.* p. 122.) Captain Isaac Stewart asserts, that on the Red River of Natchitoches, at the distance of 700 miles above its mouth, in the Mississippi, near the confluence of the river of Post (?) he discovered Indians with a fair skin and red hair, who conversed in Welsh, and possessed the titles of their origin. "They produced, in proof of what they said of their arrival on the eastern coast, rolls of parchment carefully wrapt up in otter-skins, and on which great characters were written in blue, which neither Stewart, nor his fellow-traveller Davey, a native of Wales, could decypher." (*Mercure de France du 5 Nov. 1785.*) These are, no doubt, the Welsh books recently mentioned again in the French journals. (*Revue encyclopédique*, No. 4, p. 162; and article *Homme* in the *Dict. des sciences nat.*, Vol. xxi, p. 392.) We may observe first, that all these testimonies are extremely vague for the indication of places. The last letter of Mr. Owen, repeated in the journals of Europe (of the 11th February, 1819), places the posts of the Welsh Indians on the Madwaga, and divides them into two tribes, the Brydones and the Chado-gians. "They speak Welsh with greater purity than it is spoken in the principality of Wales (!) since it is exempt from anglicisms; they profess Christianity strongly mixed with Druidism." We cannot read such assertions without recollecting that all those fabulous stories which flatter the imagination are renewed periodically under new forms. The learned and judicious geographer of the United States, Mr.

Warden, enquires justly, why all the traces of Welsh colonies and the Celtic tongue, have disappeared since less credulous travellers, and who in some sort controul one another, have visited the country situated between the Ohio and the Rocky Mountains. Mackenzie, Barton, Clark, Lewis, Pike, Drake, Mitchill, and the editors of the new *Archæologia Americana*, have found nothing, absolutely nothing, which denotes the remains of European colonies of the 12th century. The voyage also of Madoc-ap-Owen is much more uncertain than the expeditions of the Scandinavians (the Islandais Rauda, Biorn, Leif, &c.) If we were to find the vestiges of any European language in the north of America, it would be rather Teutonic, (Scandinavian, German, or Gothic), than the Celtic or Welsh, which differ essentially from the Germanic tongues. As the structure of the American idioms appears singularly strange to the different nations who speak the modern western languages, theologists have fancied they saw in it Hebrew (Semitic or Arameen); the Spanish colonists, Basque, (or Iberian); the English and French planters, Welsh, Irish, and Bas-breton. The pretensions of the Basques, and the inhabitants of Wales, who regard their languages not only as mother-tongues, but as the sources of all other tongues, extend far beyond America, to the Isles of the South Sea. I met with two officers of the Spanish and English navy, on the coast of Peru, one of whom pretended that he had heard the Basque at Tabiti, and the other Irish-Gaelic at the Sandwich islands. See above, Vol. iii, 265; and *Wilhelm von Humboldt, über die Urbew. Hispaniens*, p. 174—177). I thought it my duty to state with frankness my doubts of the existence of *Celto-Americans*. I shall change my opinion only when I am furnished with convincing proofs of the fact.

According to the traditions collected by Mr. Heckwelder, the country east of the Mississippi (*Nemasi-Sipu*, Fish-river, *Mesisip* by corruption), was heretofore inhabited by a pow-

erful nation, of gigantic stature, called *Tallegewi*, *Talligeu*, or *Allighevi*, and which gave its name to the *Alleghanian* mountains (*Allighevi*). The Allighevis were more civilized than any of the other tribes found in the northern climates by the Europeans of the 16th century. They inhabited towns founded on the banks of the Mississippi ; and the fortifications which now excite the astonishment of travellers were constructed by them in order to defend themselves against the Lenni-Lenapes (Delawares), who came from the west, and were allied at that period with the Mengwis (Iroquois). It may be supposed that this invasion of a barbarous people changed the political and moral state of those countries. The Alleghewis were vanquished by the Lenni-Lenapes, after a long struggle. In their flight towards the south, they gathered together the bones of their *relations* in separate *tumuli* ; they descended the Mississippi, and what became of them is not known." (*Trans. of the Historical Committee of the Amer. Philos. Society*, Vol. i, p. 30.) The first traditions of men are attached arbitrarily enough to such and such localities, because every nation is interested in its own vicinity ; but the lines of fortifications of a prodigious length, observed by Captain Lewis on the banks of the Missouri, opposite the Isle of Bonhomme, (*Travels*, p. 48) and on the river Plata, sufficiently prove that the ancient habitation of the Allighevis, that powerful people which I am inclined to regard as being of Tolteque or Azteque race, extended far to the west of the Mississippi, towards the foot of the Rocky Mountains. M. Nuttal, in going up the Arkansa to Cadron, was informed of the existence of an ancient entrenchment, resembling a triangular fort. The Arkansas assert that it is the work of a *white* and civilized people, whom, when they arrived in this country, their ancestors fought, and vanquished, not by force but cunning. They attribute also to a more ancient and polished people than themselves, the monuments of rough stones heaped up on the summit of the

hills. Other monuments not less curious, are the commodious roads of immense length, which the natives have traced from time immemorial, and which lead from the banks of the Arkansa, near Littlerock, to Saint-Louis on the right, and by the settlement of Mont Prairie as far as Nachitoches, on the left. (*Journal of Travels in the Arkansa territory*, 1821, p. 28.)

Do the characteristic features of colossal stature, and *white* colour, attributed to nations now destroyed, owe their origin to the ideas of power and physical force in general, to the feeling of the intellectual preponderance of the Europeans, or are those features linked with the fables of white men, legislators, and priests, which we find among the Mexicans, the inhabitants of New-Grenada, and so many other American nations? The skeletons contained in the *tumuli*, of the trans-alleghanian country, belong, for the most part, to a stunted race of men, of lower stature than the Indians of Canada and the Missouri. (*Archæologia Americana*, Vol. i, p. 209.) The bodies found on the banks of the Merrimack, have even renewed in some authors, the fable of the pygmies. (*Morse, Modern Geography*, 1822, p. 211.)

An idol discovered at Natchez (*Archæol.* Vol. i, p. 215. *Annales des Voyages*, Vol. xix, p. 45, 428), has been justly compared by M. Malte-Brun, to the images of *celestial spirits*, found by Pallas among the Mongul nations. If the tribes who inhabit the towns on the banks of the Mississipi, issued from the same country of Aztlan, it must be admitted that the Tolteques, the Chichimeques and the Azteques, from the inspection of their idols, and their essays in sculpture, were much less advanced in the arts than the Mexican tribes, who, without deviating towards the east, have followed the great path of the nations of the New World, directed from north to south, from the banks of the Gila towards the lake of Nicaragua. In the narrative of the voyage of Mr. Eversman to Bokhara, we find a striking description of a mountain made

by the hands of man (*cerro hecho a mano*), half a league in circumference, situated in the middle of the town, and serving for the base of the palace of the Chan. This artificial hill, called *Aerk*, rises in the middle of a plain, and strikes the eye of the traveller from afar; it is decorated with bricks and clay. I have often in my works dwelt on the analogy between the Mexican *teocallis*, and the pyramid of Belus, and other edifices with stories or steps, of western Asia. We find in the *Aerk* of the Chan of Bokhara, the same mixture of bricks and clay spread in layers, that characterizes the construction of the pyramid of Cholula.

It is probable enough that the invasion of the Lenni-Lenapes, and the destruction of the power of the Allighewis, were connected with the migration of the Caribs. Without warranting their northern origin, and their passage from Florida to the Lucayan islands, I shall collect at the end of this note, the result of my researches on that important association of nations, so long calumniated by travellers. The Caribs of the continent, whose country still extends from the coast of the province of Nueva-Barcelona (*Misiones de Piritu*), along the banks of the Carony, the Essequibo, the Cuyuni, and the Rio Branco, as far as the equator, call themselves *Carina*. The Ottomaques call them *Caripina*; the Maypures, *Caripuna*. This is nearly the word *Callipinam* (in confounding the *l* and *r*,) of the language of the women in the Carib Islands. (See above, Vol. iii, p. 284. *Gili*, Vol. i, p. xxxv; Vol. iii, p. 107.) The Caribs of the West Indies divide their nation into inhabitants of the isles, or *Gubao-bonon*, and inhabitants of the continent, or *Baloue-bonon*. (Ile. *oubao*; habitation, *icabanum*, or *icabatobon*; continent, *baloue*.) *Rocheport, Hist. des Antilles*, p. 325, 658. *Breton, Dict. Caribe*, p. 32. The following are the names of the islands in the Carib tongue: Antigua, *Ouala*; Saint Bartholomew, *Ouaralao*; Saint-Martin, *Oualachi*; Saint-Croix, *Amonhana*, *Ayay*, or *Hay-hay*; (*Petr. Mart. Ocean*,

p. 54); Anguilla, *Maliouana*; Domingo, *Ouaitouconbouli*; Barbadoes, *Ouahomoni*; Marigalante, *Aichi*; Saint-Christopher, *Liamagana*; Guadaloupe, *Calancacura*, (of which Petrus Martyr Oc., *Lib. ix*, fol. 63, has made *Caraqueira*); the Cape land only *Balaorcone*; the low-land only *Kaerebone*; Portorico, or San Juan, *Borriken* or *Oubouemoin*. I have collected these names because the knowledge of them becomes indispensable to those who would study the geography of America at the beginning of the 16th century. I shall add some other names of islands, which, however, are not Carib: Guadaloupe, *Guacana*. (*Gomara, Hist.* fol. xxiii); Saint Domingo, or Isla Española, *Haïti* and *Quizqueja*. The first of these names signifies, in the language of the country, asperity, or mountainous place; the second, *Great Land*. (*Gomara*, fol. xvi); Cuba or Fernandina; Jamaica, *Santiago*; Trinidad, *Cairi*. The appearance of the Caribs is every where the same. Laet described those of the banks of the Marwina (Marony), two hundred years ago, exactly as I found the Caribs of the Llanos of Cari. “Mares sunt procero et obeso corpore, capillis in orbem detonsis, instar coronæ sacerdotalis et cutem rubro colore tincti; velant pudenda panniculo quodam unum palmum lato et duos longo, cætera, nudi: foeminæ pusillo sunt corpore.” (*Descript. of the West Indies*, p. 647. See also *Archæol. Americana*, Vol. i, p. 365—433.) The geographical denominations of *Caribana*, *Carini*, and *Cariari* merit some investigation. The gulph of Uraba, (gulph of canoes, for *uru* signifies canoe, *Petr. Mart.* p. 32 C.), into which the great Rio Atrato throws itself, (Rio San Juan or Rio Dabeiba), did not bear the name of the gulph of Darien in the 16th century. A province situated between the mouth of the Rio Sinu (Zenu), and that of the Atrato, was then called *Caribana*. Gomara (*Hist. de las Indias*, 1553, fol. 30) names the following places from east to west: “*Caribana, Zena, Carthagena, Zamba y Santa Marta*.” The cape that bounds the gulph of Darien

on the east, still bears the name of *Punta Caribana*, as I have already mentioned in the text. In speaking of Alonzo de Ojeda, Gomara says, "Saliò a tierra en Caribana (solar de Cariben como algunos quieren) que esta a la entrada del golfo de Uraba. Del golfo de Uraba cueutan 70 leguas hasta Cartagena. Otro golfo esta en medio del Rio Zenù y Caribana de donde se nombran los Caribes." (*L. c.*, fol. ix et xxxi.) Further eastward, the Caramares Indians (Caramairi), inhabitants of the coast where the port of Carthagena is now situated, believed also that they were of Carib origin. (*Petr. Mart. Oc.* p. 26, *Her. Dec.* 1, p. 179.) Herera, generally very exact in his geographical information, calls a bay on the eastern coast of Veragua, *Caribaco*, a circumstance the more fitted to fix attention, as the nations termed Caribs of Uraba, placed their first dwellings beyond the Rio Darien or Atrato. "Decian los Indios de esta region que havia tido su naturaleça pasado el Gran Rio de Darien." (*Dec. I*, p. 202.) But the most ancient name of the bay of Caribaco, between Cartago and the Laguna Chiriqui, is Caravaro, or Corobaro. (*Gomara Hist.*, fol. viii. *Her. Descr.*, p. 29. *Læt*, p. 345.) There existed no doubt to the west, anthropophagic nations, who, as Christopher Columbus has said (in the *Lettera rarissima del 7 di Junio 1503*) "mangiavano uomini como noi mangiamo oltre animali." Cariari or Cariai, which I erroneously confounded (vol. v, p. 606) with Caribana, was situated at the south of cape Gracias a Dios and the isle of Quiribiri, probably near the mouth of the Rio San Juan, which is the *desaguadero* of the lake of Nicaragua, and one of the most important points for the projected communication between the two seas. It was at Cariai that Columbus, by an illusion of his ardent imagination, thought he heard mention made of China, (Catay), and the river Ganges. The inhabitants were not of Carib race, but very mild, and given to commerce. Columbus speaks ill of the women only of this country, whom he calls licentious en-

chantresses. “ Quando aggjionsi, (he writes to the king and queen of Castile,) incontinente mi mandarono due fanciulle ornate di richi vestimenti : la più di tempo non saria di età di anni undici, l'altra di sette ; tutte due con tanta pratica con tante atti et tonto vedere che saria bastato, se fossero state puttane pubbliche vinti anni. Portovano con esse loro polvere di incantamenti e altre cose della loro arte.” The admiral resisted all these arts of seduction, and hastened to send the young girls on shore. (*Lettera rar.*, p. 9. 25. *Petr. Martyr. Oc.*, p. 53. *A. Her. Dec. I*, p. 132.) The name of *Cariari* appears a second time in the north-east part of South America. Gomara, in describing the coast from west to east, adds, “ De Sant Roman al golfo triste (entre Punta Tucacas et Portocabelo) ay 50 leguas en que cac Curiana (Coro el pais de los Curianas. *Per. Nar.* vol. iii. p. 526.) Del golfo triste al golfo de *Cariari* ai 100 leguas de costa, puesta en 10 grados y que tiene a puerto de Canafistola Chiribichi y Rio de Cumana, y punta de Araia.” (*Hist. de las Indias*, fol. viii.) From this ancient *Portulan* it results, that, if the golfo di *Cariari* is not identical with the gulph of *Cariaco*, it is but at a small distance. Is this repetition of the same geographical denominations on the coast of Veragua, and that of Cumana, connected with the ancient migrations of the nations of Carib race ? What I stated in the text, of the knowledge the Caribs of Uraba had of hieroglyphic paintings, is founded on the following passage : “ Legum peritus dictus Corrales, Dariensium (Futeracæ et Caribanæ) prætor urbanus, inquit se occurrisset cuidam fugitivo ex internis occidentali-bus magnis terris qui ad regulum repertum a se profugerat. Is legentem cernens prætorem insilivit admirabundus atque per interpretis, qui reguli hospitis sui linguam callebant : en quid et vos libros habetis, en et vos characteris quibus absentes vos intelligat assequimini ? Oravit una ut apertus sibi libellus ostenderetur, putans se literas patrias visurum. Dissimiles reperit eas esse.” (*Petr. Mart. Oc.*, p. 65. *D.*)

Among the Caramares also, who call themselves of Carib race, we find some traces of foreign cultivation. “Architecti pererantes a littore parumper in frusto candidi marmoris se incidisse dixerunt. Putant peregrinos ad eas terras venisse quondam qui marmora e montibus aliquando scinderent et putamina illa in plano reliquerint.” In a country almost entirely destitute of historical traditions, we feel an interest in a period anterior to the barbarism in which the Europeans found the hot regions of America, on the east of the Andes. These nations of Cauchieto, near Coro or Cuiriana, of Caramairi (near Cathagena), Caribana and Cariari, were rich in gold that came from the inland mountains. A part of this gold was mixed with $\frac{1}{5}$ of silver. It was the electrum of the ancients, the native auriferous silver, or as the *Conquistadores*, called it, from a word of the language of Haiti, *guanin*. (*Petr. Mart. Oc.*, p. 22.) In this passage *quanini* or rather *nini*, for *qua* is a form affixed, is falsely translated by aurichalcum.) Herera, in his *Decades*, (i. p. 79), gives the name of *quanines* to all sorts of necklaces made of gold of mean alloy. (See the words of the Haitian tongue that have not been collected by Gili, vol. iii. p. 224, in *Petr. Mart.* p. 59, 61.) In my sketch of the Carib nations I have not spoken of this custom attributed to the men, of stretching themselves on a hammock, and undergoing a long fast, after the delivery of their wives. It appears that this strange practice belonged to a small number of Carib tribes, and was more common among the other nations of the Oroonoko and the Amazon. (*Garcia*, p. 172. *Southey*, vol. i. p. 642). This custom was found heretofore among the Iberians, the Corsicans, and the Tibareni. (*Apollon. Rhod. Argonaut.*, Lib. 2, v. 1009-1014.) In several provinces also of the south of France, husbands *faisoient couvade* at the birth of a child. The tall stature of the Caribs of the continent sufficiently confirms their northern origin; the first travellers were struck by the extraordinary height of the na-

tives of Florida. Luis Velasquez de Ayllon found in his expedition (1520), on the coast of Chicora and at the mouth of Río Jordan (between Savannah and Charlestown, in south Carolina), a race of Indians as tall as the Caribs, but with long hair, “ Por aquella casta arriba hombres hai mui altos y que parecian gigantes.” (*Gomara*, fol. 22. *Herera*, Dec. ii, p. 259. *Læt.*, p. 96.) The travellers of the 16th century, who, like modern travellers, had the rage of explaining every thing, believed that the Indians of Chicora softened their bones by taking the juice of herbs, and lengthened their members by stretching them out from time to time. With respect to the Asiatic origin (Araméenne) of the Caribs, we shall only mention further the Phenician and Roman money, which it is asserted has been found in the United-States ; it was pretended that this money was of the 3rd century, and had been discovered in a cavern near Nashville; but it is now known (*Archæologia*, vol. i. p. 119.) that they were buried there either to deceive, or accidentally, with English money, by European planters. The Carthaginian money of Louisiana is fit to be placed by the pretended inscriptions of Dighton, found in the bay of Naraugaset, and on which Count de Gebelin has founded such absurd hypotheses. (*View of the Cordilleras*, vol. i. p. 60.) Is it very certain that the fine shell, 9 inches long and 7 broad, discovered in a *tumulus* near Cincinnati, is identical with the *Cassis cornutus* of the archipelago of the Asiatic islands ? (*Long's Exped.* vol. i. p. 64).



NOTE B.

In order to facilitate the comparison of the late political associations formed on the new continent, with the ancient states of Europe, I shall here give a sketch of the surfaces, and their population. The different countries are ranged according to their extent, which is the least variable statistical element. Every member has been the object of a particular discussion, and I have consulted every statistical work to which I could find access. When the estimates of the *area* differed considerably, I calculated anew the surfaces according to the best maps. The *area* of the Iberian peninsula, for instance, is estimated at 18,155 square leagues, and not, as M. Antillon asserts, at 18,443 ; Spain, which was heretofore believed to contain 16,097, or 15,863 square leagues, has only 15,005. (*Principios de Geografia*, p. 135. *Elementos de la Geogr. de Espana*, 1815, p. 141, 143.) For the *area* of Portugal (3,150 square leagues), I have followed the calculation of colonel Franzini (*Balbi, Essai statist. sur le Portugal*, Tom. i. p. 67). The population in my sketch is chiefly applicable to the years 1820 and 1822. That of France is founded on the enumeration of 1820, published by M. Coquebert de Montbret, and comprehending the army. The population of England is conformable to the enumeration of 1821. (See *Rickman, Enumeration of Parish Registers*, 1823, p. 33 and 35). For the population, and the *area* of Egypt, I am indebted to the unpublished researches of M. Jomard.



COMPARISON OF THE GREAT POLITICAL DIVISIONS
ARRANGED ACCORDING
TO THE ORDER OF THEIR RESPECTIVE EXTENT.

Square Ma-
rine Leagues,
20 to a degree.

AMERICA, from Cape Horn as far as the pa-
rallel of Melville's Sound, and Cape Barrow
(comprehending the West Indies and New-
foundland)

1,186,930

Population, 34,284,000. By the square
marine league, 29.

RUSSIAN EMPIRE

316,000

Population, 54 millions. By the square
league, 87.

(Half-surface of the Moon, 614,768 square
leagues.)

NORTH AMERICA, from the south-east extremity
of the Isthmus of Panama, to 68° of north
lat. (the continental part only, without the
West India islands

607,337

Population, 19,650,000. By the square
league, 32.

SOUTH AMERICA, on the south of the isthmus of
Panama, without the West India islands.....

571,000

Population, 12,161,000. By the square
league, 21.

ASIATIC RUSSIA, taking Kara, and the moun-
tains Oural and Jaik for the western boun-
dary.....

465,600

Population, 2 millions. By the square
league, 4.

CHINESE EMPIRE, comprehending the new west-
ern possessions of Taschkent, Kokan, and
Kogend

463,200

Population, 175 millions. By the square
league, 377.

| COMPARISON OF THE GREAT POLITICAL DIVISIONS ARRANGED ACCORDING TO THE ORDER OF THEIR RESPECTIVE EXTENT. | Square Ma- rine Leagues, 20 to a degree. |
|--|--|
| SPANISH AMERICA, comprehending the islands Population, 16,785,000. By the square league, 45. | 371,400 |
| EUROPE, as far as the Oural. Population, 195 millions. By the square league, 639. | 304,700 |
| PORTUGUESE AMERICA, (Brazil) Population, 4 millions. By the square league, 15. | 257,000 |
| ENGLISH POSSESSIONS IN NORTH AMERICA, of which the countries altogether savage, La- brador, and New North and South Wales) form $\frac{1}{4}$ or 157,000 square marine leagues ... Population, 62,000, without the inde- pendent Indians. | 205,000 |
| UNITED STATES, from the coast of the Atlantic to that of the Pacific Ocean..... Population, 10,220,000. By the square league, 58. | 174,300 |
| EUROPEAN RUSSIA, as far as Oural, (compre- hending Poland and Finland) Population, 52 millions. By the square league, 345. | 150,400 |
| CHINA, properly so called Population, 150 millions. By the square league, 1172. | 128,000 |
| BUENOS-AYRES Population, 2,300,000. By the square league, 18. | 126,800 |
| INDIAN PENINSULA, (Hindustan)..... Of which British India (with the protected | 109,200 |
| VOL. VI. Z | |

| COMPARISON OF THE GREAT POLITICAL DIVISIONS, ARRANGED ACCORDING TO THE ORDER OF THEIR RESPECTIVE EXTENT. | Square Marine Leagues, 20 to a degree. |
|--|---|
| countries) 90,100 square leagues. Population, 73 millions. Independent India, 19,000 square leagues. Population, 28 millions. | |
| Total Population, 101 millions. By the square league, 925. | |
| UNITED STATES, west of the Mississippi Population, 816,000 ; with the Indians, 376,000. By the square league, 4. | 96,600 |
| NEW SPAIN WITH GUATIMALA..... Population, 8,400,000. By the square league, 95. | 92,600 |
| COLUMBIA, (ancient vice-royalty of New Grenada, with the Capitania-general of Caraccas) Population, 2,785,000. By the square league, 30. | 92,000 |
| UNITED STATES, east of the Mississippi Population, 9,404,000. By the square league, 121. | 77,700 |
| NEW GRENADA (with Quito) Population, 2 millions. By the square league, 34. | 58,250 |
| BRITISH EMPIRE IN INDIA Population, 73 millions. By the square league, 810. | 90,106 |
| α Possessions of the Company (the three Presidencies with the provinces newly conquered). Area, 49,200 square leagues. Population, 55½ millions. By the square league, 1128. | |
| € Countries placed under the protection of the Company (Nizam, Rajah of | |

| COMPARISON OF THE GREAT POLITICAL DIVISIONS, ARRANGED ACCORDING TO THE ORDER OF THEIR RESPECTIVE EXTENT. | | Square Ma- rine Leagues, 20 to a degree. |
|---|--|--|
| Mysore, l'Oude, of Nagpoor, &c.) <i>Area</i> , 40,900. Population, $17\frac{1}{2}$ millions. By the square league, 428. | | |
| PERU | | 41,400 |
| Population, 1,400,000. By the square league, 34. | | |
| SWEDEN AND NORWAY | | 39,100 |
| Population, 3,550,000. By the square league, 90: | | |
| VENEZUELA, (the ancient Capitanía-general) ... | | 33,700 |
| Population, 785,000. By the square league, 23. | | |
| THE 15 ATLANTIC STATES OF THE UNITED STATES OF AMERICA | | 30,900 |
| Between the extreme limits of Georgia and the Maine, consequently without the Flori- das, but on both sides of the Alleghanies. | | |
| Population, 7,421,000. By the square league, 240. | | |
| AUSTRIAN MONARCHY | | 21,900 |
| Population, 29 millions. By the square league, 1324. | | |
| GERMANY | | 21,300 |
| Population, $30\frac{1}{2}$ millions. By the square league, 1432. | | |
| IBERIAN PENINSULA (Spain and Portugal) | | 18,150 |
| Population, 14,619,000. By the square league, 805. | | |
| FRANCE WITH CORSICA | | 17,100 |
| Population, 30,616,000. By the square league, 1790. | | |

| COMPARISON OF THE GREAT POLITICAL DIVISIONS, ARRANGED ACCORDING TO THE ORDER OF THEIR RESPECTIVE EXTENT. | | Square Ma- rine Leagues, 20 to a degree. |
|---|--|--|
| SPAIN | | 15,000 |
| Population, 11,446,000. By the square league, 763. | | |
| CHILI | | 14,300 |
| Population, 1,100,000. By the square league, 76. | | |
| ITALY | | 10,240 |
| Population, 20,160,000. By the square league, 1967. | | |
| BRITISH ISLANDS..... | | 10,000 |
| Population, 21,200,800. By the square league, 2120. | | |
| <i>a</i> England with the principality of Wales. <i>Area</i> , 4840 square leagues. Population, 12,218,500. By the square league, 2524. | | |
| <i>c</i> Scotland with its Isles. <i>Area</i> , 2470 square leagues. Population, 2,135,300. By the square league, 864. | | |
| <i>y</i> Ireland. <i>Area</i> , 2690 square leagues. Population, 6,847,000. By the square league, 2545. | | |
| PRUSSIAN MONARCHY | | 8,900 |
| Population, 11,663,000. By the square league, 1311. | | |
| ARCHIPELAGO OF THE WEST INDIES | | 8,300 |
| Population, 2½ millions. By the square league, 301. | | |
| STATE OF VIRGINIA..... | | 5,400 |
| Population, 1,065,000. By the square league, 197. | | |
| PROVINCE OF CARACCAS, (with Coro) | | 5,200 |

| COMPARISON OF THE GREAT POLITICAL DIVISIONS, ARRANGED ACCORDING TO THE ORDER OF THEIR RESPECTIVE EXTENT. | | Square Ma- rine Leagues, 20 to a degree. |
|---|--|--|
| Population, 420,000. By the square league, 40. | | |
| ENGLAND..... | | 4,840 |
| Population, 12,218,500. By the square league, 2524. | | |
| STATE OF PENNSYLVANIA | | 3,900 |
| Population, 1,049,500. By the square league, 269. | | |
| INTENDANCE OF MEXICO | | 3,800 |
| Population, 1,770,000. By the square league, 465. | | |
| PORTUGAL | | 3,150 |
| Population, 3,173,000. By the square league, 1007. | | |
| SWITZERLAND | | 1,330 |
| Population, 1,940,000. By the square league, 1175. | | |
| EGYPT..... | | 1,400 |
| Comprehending under that name the coun- try only that receives or has received the waters of the Nile. The space between the Red Sea and the Lybian Oasis, compre- hends 11,000 square marine leagues, but $\frac{7}{8}$ form only a desert. | | |
| Population, 2,489,000. By the square league, 1777 (in the cultivated part only). | | |
| GALICIA | | 1,650 |
| Population, 1,400,000. By the square league, 1053. | | |
| KINGDOM OF ARAGON | | 1,230 |

| COMPARISON OF THE GREAT POLITICAL DIVISIONS, ARRANGED ACCORDING TO THE ORDER OF THEIR RESPECTIVE EXTENT. | | Square Ma- rine Leagues, 20 to a degree. |
|--|--|--|
| Population, 660,000. By the square league, 537. | | |
| HOLLAND (the ancient Republic) | | 900 |
| Population, 2,100,000. By the square league, 1330. | | |
| KINGDOM OF VALENCIA..... | | 640 |
| Population, 1,200,000. By the square league, 1874. | | |
| DEPARTMENT OF THE CHARENTE... .. | | 196 |
| Population, 347,000. By the square league, 1865. | | |
| This department and that of the Meurthe, furnish at the same time the mean extent, and population of a department of France. | | |

The estimate of the whole *area* of America is founded on the following calculation ; I found in tracing the triangles by maps on a great scale :—

| | |
|--|-------------------------|
| I. <i>South America</i> , without comprehending the Isthmus of Panama | Sq. Leagues. 571,290 |
| Columbia (without Veragua, and without the Isthmus) | 89,344 |
| Peru, Chili, and Buenos Ayres, together | 182,430 |
| Brazil..... | 256,990 |
| English, Dutch, and French Guyana | 11,320 |
| Patagonian lands, south of the Rio Negro | 31,206 |
| <hr/> | |
| 571,290 | |

Sq. Lea.

| | |
|--|---------|
| II. Isthmus of Panama, and province of Veragua | 2,600 |
| III. Guatimala and New Spain together | 92,570 |
| IV. The almost desert country which is not comprehended in the territory hitherto claimed by the government of the United States, and that of New Spain, namely, 1° on the west of Rio del Norte, between New Mexico, Sonora, and New California, from 35° to 42° of north latitude, from the port of San Francisco as far as cape San Sebastian ; a surface of 41,162 square leagues, washed by the Rio Colorado : 2° on the east of the Rio del Norte, between New Mexico, the intendancies of Durango, and San Luis Potosi, the territory of the Arkansas, and the state of Missouri ; a surface of 20,320 square leagues | 61,482 |
| V. Territory of the United States | 174,300 |
| VI. The whole space between the northern boundary of the United-States, and the parallel of 68°, which passes, according to the recent discoveries of Captain Franklin, on the south of the Archipelago of the Duke of York, by the capes Mackenzie, Barrow and Croker. That immense territory comprehends the English possessions, Labrador, the country of the Chipeways and Russian America, (excluding Greenland, West Main, beyond the parallel of 68°, and Cumberland Island | 276,385 |
| VII. Insulary America, according to the calcu- | |

Sq. Lea.

lations of M. Lindenau and the maps of
the Deposito hidrografico of Madrid
(*Zach's Monatl. Corresp.*, 1817. Dec.)... 8,303

Total 1,186,930

It results from these statements :

Sq. Mar. Lea.

North America, on the north of the south-
east extremity of the isthmus of Pana-
ma, contains 607,337

Archipelago of the West Indies..... 8,303

Population, 2,473,000.

South America, on the south of the south-
east extremity of the Isthmus of Panama 571,290

Population, 12,161,000.

1,186,930

If we compare these numbers with those
furnished by the most esteemed and re-
cent statistical works, we shall find, in
reducing the English miles and geogra-
phical leagues uniformly to square ma-
rine leagues, of 20 to a degree, the
total *area* of America with Greenland,
to be, according to Mr. Morse, (*A
new system of Geography*, 1822, p. 51,) 1,184,800 square leagues ; according to
M. Balbi (*Compendio di Geografia uni-
versale*, 1819, p. 308), 1,327,000 square
leagues, America, nearly as far as the
parallel 68°, according to M. Hassel
(*Gaspari, Hassel, und Cannabrich, Vollst.
Erdbeschreibung*, 1822, B. 16), of
1,072,026 square leagues ; namely :

| | Sq. Lea. |
|----------------------------|----------|
| <i>North America</i> | 539,453 |
| <i>Insulary</i> | 8,018 |
| <i>South</i> | 524,555 |

1,072,026

Mr. Hassel having published the detail of these calculations, it is easy to recognize the continental parts, which in his estimations differ considerably from mine, made with a more complete knowledge of the limits, and with maps rectified by a great number of astronomical observations. In North America, a space of 61,000 square leagues, between the parallels of 35° and 42°, has been forgotten in the account, as is not *hitherto* comprehended in the territory of Mexico and the United States. In South America, the *area* of Buenos Ayres, Peru, and Brazil have been estimated 32,000 + 3,000 + 77,000 = 112,000 square leagues too little; and the *area* of Columbia and Chili 58,000 + 5,000 = 63,000 too great. Mr. Hassel by applying these corrections, would find for North America, 601,000 square leagues; for South America, 573,000, and for the whole New Continent with the West Indies, nearly as I have done, 1,182,000 square leagues, 20 to a degree.

The division of the Spanish colonies, or to speak with more precision, of the countries inhabited and governed by the Spanish Americans, north and south of the equator, is as follows :

| | |
|--|---------------|
| On the continent of North America, comprehending the Isthmus of Panama, square leagues : | 95,170 |
| Population, 3,480,000. | |
| In the Archipelago of the West Indies .. | 4,430 |
| Population, 800,000. | |
| On the continent of South America | 271,730 |
| Population, 7,505,000. | |
| | <hr/> 371,380 |

These three groups yield altogether, a population of 16,785,000. (See above, p. 127 and 142.)

The surface of Indostan, and its political divisions, have been calculated with the greatest care by M. Mathieu, and myself, from a map bearing the title ; “ *New improved map of India, 1822, by Allen, Kingsbury, and Parbury.*” We found 109,190 square marine leagues, or 1,307,180 square English miles, in assigning the following limits to the peninsula of India: the mouth of the Indus and its course as far as $35^{\circ} 20'$ of lat. at the N. W. of Cashemere; the chain of the Himalaya nearest the lake Manasorovar, to the river Tistah; the Borampouter at 90° of longitude; the sea of Bengal, south of the isle of Mascal, and east of the river Sankar. I am surprised that Mr. Hamilton marks for the whole peninsula 1,020,000 square English miles, or 85,120 square marine leagues, an estimation one fifth too little. The statements of Playfair, which I have followed in my work on Mexico, and of MM. Balbi, Tempelman, and Hassel, (162,827 square leagues, 25 to a degree; 62,500 square geographical leagues; 69,750 square geographical leagues; 73,460 square geographical leagues), approach nearly the result on which I have fixed.

The following are my partial statements according to Allen's map : 1st. English territory, the Presidencies, 49,224 square marine leagues; 2nd. the country in the dependancies of the Company (tributary, subsidiary, and protected states) Rajah of Mysore, 2,635 square leagues. The Nizam, 8,126; Rajah of Nagpoor, 5,931; Holkar, 1,992; Oude, 2,952; Gykwar, 3,418; Rajpoots, 9,482; Seiks, 1,300; chiefs of Buddelkund, 1,229; Bopaul, 494; Sitarra, 1,185; Travencore, 658; Sindia, 2,398; altogether 40,900 square leagues. 3rd. Independent states : Lahore and Seizo, 10,935. Sinde, 3,643; Nepal, 4,335; Goa, Pondicherry, Chandernagor, Mahé, Tranquebar, Palicote, &c., 153: together, 19,066 square leagues. Total, 109,190 square leagues.

The population of England, according to the enumeration of 1377, was 2,300,000. The city of London then contained only 35,000. (*Lowe, Present State of England*, Ap. p. 3). The following is, according to Mr. Cleveland, the increase of the population of Great Britain within twenty-years : in 1801, the population amounted to 10,942,642 ; in 1811, to 12,596,803 ; and in 1821, to 14,353,800. In estimating the population of the Russian empire with Poland, at 54 millions, I reckoned 2 millions for the Asiatic part only. Official statements (*Petersburger Zeitschrift*, June, 1823, p. 294), give 1,606,195 to Siberia ; namely, Tobolski, 572,471 ; Tomsk, 340,000 ; Jeniseisk, 135,000 ; Irkutsk, 400,500 ; Jakutsk, 147,015 ; Ochotsk, 6,703, and Kamtschatka, 4,506 ; I add for the parts situated on the east of the Oural Mountains, that is, for $\frac{1}{4}$ of the government of Perm, $\frac{1}{7}$ of the government of Orembourg, and the Kirgises, 1,606,195 inhabitants ; Siberia, properly so called, 450,000 inhabitants.

According to the great imperial geographical map of China, the number of *taxable* persons amounted in 1790, to 143 millions. M. de Klaproth, thinks that 700,000 may be added for the army, and the persons exempted from taxation ; so that China, properly so called, probably contains 150 millions. For Tartary, 6 millions may be reckoned (with the exception of Thibet and Coréa.)

NOTE C.

WHATEVER relates to the remains of the native population having a great interest for the friends of humanity, I shall here mark : 1st, the state of the missions of the fathers of the *Observance of Saint Francis*, in the province of Barcelona, missions that are vulgarly called of Piritu, and dependant on the college of the *Purissima Concepcion de Propaganda Fide* at Nueva Barcelona ; (*See above*, Vol. vi, p. 8, &c.) 2d. The

state of the missions of the Oroonoko, the Cassiquiare, the Rio Negro, and the Atabapo, in the province of Guyana, (Vol. iv, p: 457, &c.), alike governed by the *brothers of the Observance* of the college of Nueva Barcelona: 3d, the state of the missions of Carony, east of Angostura, in the province of Guyana, confided to the Catalanian Capuchins. (Vol. v, p. 76.)

1° State of the Missions of Piritu in the province of Nueva Barcelona in 1799.

| Names of 38 Villages served by Observantin Monks. Among that number 17 are of <i>mission</i> , and 21 of <i>doctrine</i> . | Population. | | | Period of the foun- dation. | Bap- tisms. | Deaths | Marri- ages. |
|---|---------------|--------------------------------------|----------------|--------------------------------------|----------------|--------|-----------------|
| | Mar- ried. | Not mar- ried, grown up. | Chil- dren. | | | | |
| La Puriss. Concepcion de Piritu. (D.) - - | 366 | 259 | 660 | 1575 | 120 | 64 | 27 |
| S. Antonio de Clarines. (D.) - - - | 422 | 776 | 458 | 1667 | 115 | 93 | 25 |
| Nuestra Senora del Pilar. (D.) - - - | 558 | 542 | 1019 | 1674 | 204 | 108 | 46 |
| Santa Catharina de Sena del Carito. (D.) - | 200 | 220 | 241 | 1798 | | | |
| Jesus Maria Josef de Caigua. (D.) - - | 526 | 775 | 547 | 1667 | 118 | 50 | 34 |
| San Miguel - - - - - | 260 | 397 | 360 | 1661 | 60 | 42 | 19 |
| N. S. P. S. Juan de Huere. (D.) - - - | 152 | 193 | 112 | 1675 | 57 | 30 | 16 |
| San Pablo Apost. de Huere. (D.) - - - | 204 | 306 | 438 | 1680 | 101 | 68 | 21 |
| San Lorenzo de Huere. (D.) - - - | 307 | 504 | 645 | 1675 | 61 | 30 | 10 |
| S. Andres Apollin. de Onoto. (D.) - - - | 46 | 56 | 102 | 1687 | 28 | 9 | 8 |
| Nuestra Senora del Amparo de Pozuelos. (D.) | 53 | 85 | 82 | 1687 | 17 | 4 | 4 |
| San Diego. (D.) - - - - - | 58 | 42 | 95 | 1688 | 23 | 11 | 5 |
| Santo Domingo de Guzman de Araguaita. (D.) | 41 | 38 | 53 | 1690 | 16 | 10 | 4 |
| San Juan Capistrano de Furney. (D.) - - | 133 | 264 | 200 | 1680 | 40 | 22 | 10 |
| San Bernardino. (D.) - - - - - | 252 | 254 | 296 | 1675 | 72 | 55 | 7 |
| S. Josef de Curataquiche. (D.) - - - | 172 | 185 | 196 | 1679 | 47 | 28 | 12 |
| S. Matheo Ap. y Evangelista. (D.) - - - | 308 | 309 | 545 | 1715 | 84 | 60 | 20 |
| S. Vicente Ferrer de Carapa. (M.) - - - | 143 | 71 | 341 | 1793 | 34 | 20 | 13 |
| Santa Gertrudis del Tigre. (M.) - - - | 70 | 74 | 105 | 1794 | 44 | 27 | 8 |
| Nuestra Senora del Socorro del Cari. (M.) - | 134 | 198 | 188 | 1761 | 33 | 8 | 11 |
| La Puriss. Concepcion de Tavaró. (M.) - - | 98 | 113 | 143 | 1771 | 31 | 10 | 6 |
| S. Pedro Apollin. de la Puerta. (D.) - - | 128 | 175 | 195 | 1794 | 14 | 4 | 8 |
| La Divina Pastora de Guaicupa. (M.) - - | 51 | 42 | 86 | 1754 | 28 | 8 | 7 |
| Santiago, o Santa Cruz de Orinoco. (D.) - | 50 | 25 | 97 | 1796 | 28 | 8 | 10 |
| San Juan Baut. de Mucuras. (M.) - - - | 43 | 44 | 66 | 1754 | 33 | 11 | 10 |
| La Anuncion de Atapiriri. (M.) - - - | 71 | 54 | 86 | 1754 | 24 | 6 | 4 |
| S. Simon Apollin. de Moquete. (D.) - - - | 31 | 28 | 69 | 1799 | | | |
| Santa Maria de Arivi. (M.) - - - - - | 72 | 91 | 76 | 1755 | 24 | 14 | 9 |
| S. Pedro de Regalado de la Candelaria. (M.) | 33 | 25 | 50 | 1755 | 17 | 8 | 5 |
| S. Luis Chispo de Arivi. (M.) - - - - - | 41 | 89 | 95 | 1755 | 12 | 7 | 8 |
| Santo Chiunto de Pariaguan (M) - - - - | 142 | 190 | 286 | 1744 | 51 | 4 | 11 |
| Santa Cruz de Cachipo. (M) - - - - - | 109 | 164 | 252 | 1749 | 54 | 14 | 7 |
| Santa Ana de Chocopiche. (M.) - - - - | 243 | 368 | 422 | 1735 | 66 | 13 | 18 |
| S. Joaquin del Curire. (M.) - - - - - | 284 | 380 | 423 | 1724 | 63 | 20 | 15 |
| N. Senora de la Candelaria de Chamariapa. (D.) - - - - - | 181 | 126 | 351 | 1742 | 47 | 12 | 9 |
| Santa Rosa de Viterbo de Ocopi. (M.) - - | 417 | 411 | 261 | 1724 | 104 | 47 | 23 |
| N. Senora de Dolnes de Quiamare. (M.) - | 107 | 107 | 114 | 1748 | 20 | 14 | 8 |
| S. Buenaventura de la Margarita. (M.) - - | 105 | 188 | 264 | 1721 | 44 | 22 | 10 |
| | 6679 | 8180 | 10,019 | ... | 1934 | 961 | 468 |
| | 24,778 | | | | | | |

This state of the population of 1799, was communicated to me, at Nueva Barcelona, by the president of the missions of Piritu. Among 24,778 inhabitants there are only about 1,500 whites (*Espanoles*) and mulattoes : all the rest of the population is of pure Indian race. An enumeration of 1792, believed to be more exact, yielded in 16 *pueblos de mission* :

| | Souls. |
|---|--------|
| 2,196 Indian families, or | 8,284 |
| 247 whites, and free mulatto families, or ... | 1,351 |
| <i>Dispersos</i> (insulated without the villages) | 2,543 |
| | <hr/> |
| | 12,178 |

In 16 *pueblos* of *doctrina* :

| | |
|---|--------|
| 4,944 Indian families, or | 17,967 |
| 51 white and mulatto families, or | 246 |
| <i>Dispersos</i> | 40 |
| | <hr/> |
| | 18,253 |

Consequently, in all the villages subject to the government of the Observantin monks in the province of Nueva Barcelona :

| | |
|------------------------|--------|
| Indians | 26,251 |
| Espanoles | 1,597 |
| <i>Dispersos</i> | 2,583 |
| | <hr/> |
| Total | 30,431 |

Must we conclude from the comparison of the states of 1792, and 1799, that the Indian population of the province has diminished, or does not the difference proceed from the negligence of the last enumeration and the exclusion of the *dispersos* ?

2^o *State of the Missions of the Oroonoko, the Cassiquiare and the Rio Negro, in the province of Spanish Guyana, in 1796.*

| | |
|------------------|----|
| San Felipe | 52 |
|------------------|----|

| | Souls. |
|----------------------------|--------|
| San Miguel | 102 |
| San Baltasar | 80 |
| Esmeralda..... | 92 |
| Santa Barbara | 94 |
| San Fernando | 226 |
| Maypures | 48 |
| Carichana | 100 |
| Caño de Tortuga | 117 |
| Uruana | 505 |
| Encaramada | 412 |
| Cuchivero | 329 |
| Ciudad Real ... | 403 |
| Guaciparo | 98 |
| Uruana | 100 |
| Guaraguarayco | 132 |
| Aripao | 84 |
| San Pedro Alcantara..... | 226 |
| La Piedra | 163 |
| Platanar..... | 356 |
| Real Corona | 609 |
| Tapaquire ... | 429 |
| Borbon | 342 |
| Cerro del Morro..... | 150 |
| Orocopiche | 558 |
| Buenavista.. | 230 |
| Atures | 47 |
| San Carlos..... | 272 |
| San Francisco Solano | 442 |
| Tomo | 155 |
| Tuamini | 119 |
| Quirabuena | 60 |
| Maroa | 79 |
| Vaciva | 87 |
| <hr/> | |
| Total | 7298 |

3º Missions of Carony in Spanish Guyana, in 1797.

| | Souls. |
|---|--------|
| Cupapui..... | 872 |
| Santa Rosa de Cura | 925 |
| Santa Clara de Yaruapana..... | 228 |
| Aycaba | 178 |
| San Pedro de las Bocas de Paragua | 550 |
| Santa Magdalena de Currucay | 200 |
| San Serafin de Abaratayme | 273 |
| Miamo | 287 |
| Cumamo | 512 |
| Villa del Barceloneta | 414 |
| Pueblo de los Dolores de Maria..... | 301 |
| Nestra Señora del Ros. de Guatipati..... | 732 |
| San Josef de Ayma | 630 |
| San Juan Baptista de Avechica..... | 514 |
| Santa Cruz del Monte Calvario..... | 429 |
| Santa Ana de Purisa | 504 |
| Nestra Señora de los Angeles | 541 |
| San Buenavetura de Guri | 663 |
| Divina Pastora | 498 |
| Tupuqueri | 566 |
| Palmar | 698 |
| San Antonio de Usiatano | 684 |
| San Fidel del Carapo.... | 753 |
| Santa Eulalia de Murucuri | 613 |
| Pueblo del San Francisco del Alta Gracia... | 951 |
| Nuestra Señora de Belin de Tumeremo ... | 333 |
| Caruache | 400 |
| Upata | 667 |
| San Miguel de Unala..... | 487 |
| Carony | 699 |

Total 16,102

I composed, during my navigation on the Apure, the Oroonoko, the Atabapo, the Rio Negro, and the Cassiquiare,

with the aid of the missionaries, a sketch of the native tribes, who now inhabit the forests and savannahs comprehended between those rivers, and between the Caura, the Ventuari, and the Carony, on a surface of more than 19,000 square marine leagues. This geographical distribution is not without interest for the history of nations. I attempted at first to arrange the names according to the analogy of the languages, and the hypothesis which the missionaries, the sole historians of those countries, have formed on the filiation of the Indian tribes ; but I was compelled to abandon that project, because more than $\frac{7}{8}$ would have remained what the classifying botanists call *incertæ sedis*. A traveller cannot offer finished labors ; but what the reader has a right to require of him, is to present candidly such materials as he collected on the spot. Those which I here mark are disposed alphabetically, a pretty certain means of preserving them from ethnographic hypotheses, and of facilitating researches. Experience having proved to me that nations whose names appear almost identic, are sometimes of different race, I have, notwithstanding the fear of repetition, not joined arbitrarily the tribes that present those analogies of denomination. Father Caulin did not penetrate beyond the cataracts ; I have, however, made use of his work whenever the conformity of the orthography of names gave me confidence in the identity of the tribes he mentions, with those contained in my own list. A manuscript catalogue (*Catalogo de lenguas y naciones del Rio Orinoco*), kindly communicated to me by father Ramon Bueno, during my stay in the mission of Uruana, I found highly useful. I shall also cite in this sketch the pages of the *Personal Narrative*, which furnish the most ample information on the tribes now believed to be the most numerous, and important. I know that those tribes often take their denomination from words : *men, son of such or such a chief* (vol. v, p. 182) ; *descendant of such or such a courageous animal* ; there is always, however, in the

simple names of nations something monumental, which, as the learned researches of MM. Abel Remusat, Wilhelm de Humboldt, Klaproth, Marsden, Ritter, and Vater, have proved, may become of high importance to the history of distant migrations. The analogy of roots, and etymological artifices have, no doubt, given rise for ages to absurd reveries, and historical romances. We shall not recognize the Quaquas of New Andalusia, in a tribe of that name who dwell on the coast of Guinea ; or the Caraccas Indians, of Carib race, inhabiting the high vallies, in the name of an Iberian spot, cited by Ptolemy (*Geogr.* ii, 6, p. 46), and which appears connected with the *Basque* root, *car*, signifying height, summit, or elevation. (*Wilhelm von Humboldt, Urbewohner Hispaniens*, p. 68). The mutability of vowels, and the permutation of consonants, which take place in consequence of organic laws, produce, without counting the words that have imitative sounds (onomatopœia), fortuitous resemblances in thousands of tongues and dialects, of which the number might be submitted to the calculation of probabilities. If we compare one single language, not to those from one root, for instance, a semitic root, (Indo-Germanic or Welsh (Celtic), but to the whole mass of known idioms, the chance of those accidental analogies becomes the greatest possible, and from that appearance, the prodigious variety of languages of the two hemispheres seem linked together, *nexu reteformi*. Analogies of sound cannot always be considered as being analogies of roots ; and although the learned who study these analogies, have a claim to encouragement and gratitude, in thus awakening the attention of linguists, it is not less true that the study of words should always be accompanied by that of the structure of languages, and a complete knowledge of grammatical forms. It were to be ignorant of the state of modern philosophy, not to recognize the eminent services which the etymological researches of a small number of men of solid erudition have rendered within

half a century, to the philosophical study of languages, in Holland, Germany, England, and France.

Tribes of the Oroonoko, of its branches, and its tributary streams.

A.

- | | |
|--|--|
| <p>Arinacotos (Caura ; Carapo, tributary stream of the Caroni, Rio de Aguas Blancas or Rio Parime ; R. Paragua ; Berbice).</p> <p>Achaguas (Meta and Cravo, tributary of the Meta; Lower Apure).</p> <p>Achirigotos (Erevato, Paragua).</p> <p>Arivacos (Upper Caura).</p> <p>Abanis (Oroonoko, usually Atures, Amanaveni).</p> <p>Aruros (Oroonoko, east of Maypures, Amanaveni, Atures).</p> <p>Arevirianas (Ventuari, Manapiare, Erevato).</p> <p>Ajures (Ventuario, R. Paro).</p> <p>Aguaricotos (Rio Caura, near the rapids of Mura).</p> <p>Amarizanos (Meta).</p> <p>Acarianas (Puruname ; Jao).</p> <p>Aberianas (Ventuari ; Jao, sources of the Puruname).</p> <p>Amuisanas or Amozana (Cassiquiare and Rio Parime).</p> <p>Atures (sources of the Oroonoko ; Raudal Mapara).</p> | <p>Arinavis (R. Negro, Itinivini).</p> <p>Aviras (Caura).</p> <p>Arnacotos (Erevato).</p> <p>Abacarvas (sources of the Rio de Aguas Blancas or Rio Parime).</p> <p>Aruacas (Cujuni).</p> <p>Aturayos (Esquibo).</p> <p>Aturayes (R. Esquibo).</p> <p>Acurias (Berbice).</p> <p>Abacarva (Upper Paragua).</p> <p>Ariguas (Caura).</p> <p>Arevidianos (R. Parime).</p> <p>Atapeimas (Upper Oroonoko).</p> <p>Amarucatos (R. Parime).</p> <p>Avanas (Rio Auvana).</p> <p>Aquerecotos (a nation almost extinct).</p> |
|--|--|

B.

- | | |
|--|---|
| <p>Amarucatos (R. Parime).</p> <p>Avanas (Rio Auvana).</p> <p>Aquerecotos (a nation almost extinct).</p> | <p>Berepaquinavis (Rio Negro, Itinivini).</p> <p>Barinagotos (R. Paragua, tributary of the Caroni).</p> |
|--|---|

C.

- | | |
|---|--|
| <p>Chorotas (Meta).</p> <p>Cuyabas (between the Caroni and the Cuyuni).</p> <p>Chavinavi (Carib-tribe).</p> | |
|---|--|

Chapoanas (R. Negro).
 Caduvini (Esquibo).
 Cachirigotos (R. Parime).
 Chinatos (R. Parime).
 Chirapas (Auvana).
 Cabres, Caberres (Guaviare,
 Ariari, Atabapo, some at
 Cuchivero). Vol. v, p. 151,
 205, 209, 424.
 Chuenas (Cusiana, tributary of
 the Meta).
 Caridaquères.
 Chaipos.
 Candalos.
 Caparaches.
 Cataras (Meta).
 Curacicanas (Ventuari, and its
 tributary Maniapiare). Vol. v,
 p. 605.
 Cheruvichahena (Rio Negro,
 Rio Tomo).
 Carives, Caribes, Cariua, Calli-
 nago (Paragua, Upper Cau-
 ra). Vol. iii, p. 284; Vol. iv,
 p. 193, 465, 515; Vol. v,
 p. 204, 209, 360, 424; Vol.
 vi, p. 17.
 Carianas (Paragua; Ucamu).
 Cadupinapos (Upper Caura,
 Erevato).
 Chiricoas (between the Meta
 and the Apure).
 Civitenes (Ventuario, Rio Pa-
 ro).
 Carinacos (Upper Oroonoko,

Rio Negro, Macoma; Ven-
 tuari Padamo).
 Cogenas (R. Negro).
 Cariguanas (R. de Aguas
 Blancas).

D.

Deesanas (Cassiquiare).
 Darivasanas (Upper Oroo-
 noko).
 Davinavi (Ucamu).
 Daricavanas (sources of the
 Rio Negro).

E.

Equinabis or Marivitanos (Up-
 per Rio Negro between the
 Rio Temi and Azacami).
 Emaructos (Upper Oroonoko).

G.

Gujancamos or Guayanicomos
 (Caura).
 Guainares (sources of the Ma-
 tacona). Vol. v, p. 565.
 Guaycas (sources of the Oroo-
 noko, Cano, Chiguire). Vol.
 v, p. 565, 760.
 Guaraunos (mouth of the Oroo-
 noko.) Vol. iii, p. 216, 277;
 Vol. v, p. 729.
 Guaripacos (Upper Caura).
 Guaypunabis (Inirida). Vol. v,
 p. 205. (Serrania Mabicori
 and Cano Nooque). Vol.

iv, p. 521 ; Vol. v, p. 204,
209, 425, 489.

Guanimanase (Rio Negro).

Guamos (Lower Apure). Vol.
iv, p. 534 ; Vol. v, p. 565,
639.

Guaiquiris (sources of the Rio
Caripo).

Guasurionnes (southern bank
of the Upper Rio Negro).

Guapes (Rio Negro).

Guacavayos (Esquibo).

Guajamura (R. de Aguas
Blancas).

Guinaves (Upper Oroonoko).

Guahibos (Meta). Vol. iv, p.
569 ; Vol. v, p. 9, 151, 234,
644.

Guayres (Upper Oroonoko).

Guabaribos (Upper Oroonoko).
Vol. v, p. 563.

Guarares (R. Parime).

Guayumoros (Upper Oroono-
ko).

Guaranaos (R. Parime).

Gajones (Upper Oroonoko).

Guaneros (Padamo).

Guacamayas (Padamo).

Guaiquiris ? perhaps hereto-
fore between the Caura, et
the Cuchivero. Vol. iii, p.
215 and 281, note ‡.

J.

Jaditanas (Erevato).

Juaos (Caura).

Jabacuyanas (Upper Oroo-
noko ; Conoconumo, Jao).

Jayres (Upper Oroonoko) Rio
Conoconumo ; Jao).

Javarannas (Ventuari, Mania-
pire).

Jayures (Jao, Conoconumo).

Jaruros (between the Meta and
the Apure, between the
Ventuari and the Jao.) Vol.
iv, p. 417, 563 ; Vol. v,
p. 9.

Jcanicaros (Upper Oroonoko).

Jchapaminaris (Padomo).

Jpurucotos (Paragua). Vol. v,
p. 838.

K.

Kiriquiripas (Paragua, Ere-
vato).

Kirikiriscotos (Berbice).

L. and M.

Libirianos (Ventuario, Rio
Paro).

Maypures heretofore (Raudal
Quittuna ; between the R.
Sipapo and R. Capuana ;
Jao ; Rio Negro et Pata-
vita.)

Maciniravi (Caura).

Macurotos (Crevato, Upper
Caura).

Manetibitanas (R. Siapa).

Marebitanas (R. Negro).

Mayepien (R. Negro).

Mayanaos (sources of the Es-
quibo).

Maconas (Padamo).

Macusis (R. Aguas Blancas,
Esquibo).

Maysanas (Cassiquiare).

Mapojos (Caura).

Macos-Piraoas (Cataniapo).
Vol. v, p. 124, 152.

Macos (Caura, Ventuari, Pa-
rueni, Paragua). Vol. v,
p. 605.

Macos-Macos (sources of the
Oroonoko).

Maquiritares (between the Jao
and the Padamo; Ventuari).
Vol. v, p. 505, 566.

Manivas (Rio Negro, Aquio).

Mariusas (mouth of the Oroo-
noko).

Maguisas (Upper-Caura).

Meyepures (Oroonoko, Ama-
naveni, Ventuari, Caura,
Guanami).

Morononis (Jao, Ventuari).

Maripizanas (Cassiquiare, R.
Guapo, R. Negro). Vol. v,
p. 206.

Mariquaitares (Padamo).

Matomatos (sources of the
Oroonoko).

Manisipitanas (R. Negro).

Marivisanas (Ventuari).

Mapanavis (Ventuari).

Motilones (Caura).

Maymones (U. Oroonoko).

Massarinavi (Ventuari).

Marivitanos (Rio Negro). Vol.
v, p. 206, 208.

Maisanas (Cassiquiare).

O.

Otomacos (between the Meta
and the Apure). Vol. v, p.
515, 563, 568, 639, 669.

Ocomesianas (R. Guanami,
western bank of the Jao).

Ojes (Cuchivero).

P.

Paraguanas (source of the Es-
quibo).

Piriquitos (R. Parime).

Panivas (Padamo).

Pujuni (Caura).

Puinabis (Guaviare).

Poimisanos (between Atabapo,
Inirida et Guaviare).

Paragini (Ventuari).

Purucotos (Cara).

Parabenas (Caura).

Poignaves, or Puinabis (Ini-
rida). Vol. v, p. 149, 566.

Paracaruscotos (Paragua).

Puinaves (Ventuari). Vol. v,
p. 204.

Purugotos (Upper Caura, Pa-
ragua).

Paudacotos (Upper Caura).

Paravenes (Erevato).

Parenas (Oroonoko, Mataveni, Ventuari). Vol. v, p. 145.

Pottuari (Venituari).

Parecas (Vichada, Venituari, between the Cuchivero and the Cano Tortuga.)

Puipuitrenes (Ventuario, Paro).

Purayanas (R. Aguas blancas, Caura.)

Parabenas (R. Aguas blancas, Caura.)

Putchinirirnavos (Upper Rio Negro. Vol. v, p. 247).

Pajacotos (Padamo).

Palenkes (Caura).

Paraivanas (Padamo).

Pajuros (Cuchivero).

Q.

Quriquiripos (Caura).

Quirupas (Oroonoko; usually Atures).

Quaquas (Cuchivero). Vol. iii, p. 282.

Quinarao (Upper Oroonoko).

S.

Salivas (S. Meta, Paute, between Vichada and Guaviare). Vol. iv, p. 545.

Saparas (Padamo).

Sercucumas (Erevato).

Sagidaqueres (Atabapo, Temi, Uua, tributary of Guaviare).

T.

Tabajaris (Caura).

Tacutacu.

Taparitas (between the Meta and Apure).

Tomuzas (Lower Oroonoko).

Tasumas (Aguas blancas Esquibo).

Tamianacos (south-east of the Encaramada). Vol. iii, p. 284; Vol. v, p. 595, 626.

Toazannas (Siapa).

Taparitas (Apure).

Tiau (nation extinct).

Tujazonas.

Tamanaques (south-east of the Encaramada). Vol. iii, p. 284; Vol. v, p. 595, 626.

U. V. et Z.

Ules.

Urumanavi (Upper Oroonoko).

Vaniva.

Varinagotos (Carony, Carapo.)

Voquiaries, (nation almost extinct, Upper Oroonoko).

Viras (Caura).

Zaparas (Esquibo, Rio de Aguas blancas).

I have just given a list of more than 200 tribes spread over a space a little larger than France ; these tribes believe themselves to be at least as foreign to each other as the English, the Danes, and the Germans. I compare expressly the nations of Europe that belong to the same root ; for we have often observed in this work, how much, in the dispersion, I had almost said in the great shipwreck of the American nations, simple dialects have by degrees taken the appearance of languages essentially different. The state of the organs of the voice, the permutation of consonants, the carelessness of pronunciation, render it difficult to recognize the analogy of the roots. The researches of MM. Hecke-welder and Duponceau, in North America, render it probable that the tongues scattered heretofore over more than 120,000 square leagues, between the Alleghanies and the Rocky Mountains, the lakes of Canada and the Caribbean sea, are reduced to a very small number of roots, of which the Lenni-Lenape (Delaware), the Iroquois, and the Floridian are the most important. It may be enquired, whether among the tribes of the Oronoko of which we have given the nomenclature, and which, it is painful to relate, now comprehends perhaps not 80,000 individuals, there exist 8 to 10 languages different from each other, like the German, the Slavonian, the Basque, and the Welsh? This question can only be solved by the study of the printed grammars which we owe to the care of the missionaries. My brother M. William de Humboldt, the sole Helenist who has acquired a profound knowledge of the Sanscrit, the semitic tongues, and almost all the idioms of Europe, without excluding the Basque, the Welsh, and the Hungarian, has been employed for a great number of years on the whole of the languages of the new continent. He possesses more materials for this study than have hitherto been collected, and the work in which he will soon make known the tongues of the new continent, will spread a new light on that important branch of our knowledge.

I have often spoken in my voyage to the Oroonoko, of the influence produced by the immense savannahs of America (between the Apure, the Meta, and the Guaviare, and between the sources of the Essequibo, and the Rio Parime, or Rio Branco), on the manners and language of the natives. The Llanos excite and cherish the taste for a wandering life, even in a region of the world where there are no herds to give milk, and where the *Indios vagos y andantes* live only by hunting and fishing. The Llanos contribute also to generalize a small number of tongues, and spread them over a vast space. (Vol. iv, 445 ; Vol. v, 14, 605.) The greatest mass of the nations we have just named inhabit a country covered with forests and mountains, and in which there is no other path than the course of rivers. The difficulty of removing, and the obstacles which the force of the vegetation, and the depth of the rivers oppose to hunting and fishing, have led the savage to become an husbandman. It is on this mountainous region, between the Esmeralda, the sources of the Carony, the sources of the Apure, and that of the Atabapo, where man is insulated and immoveable, that the appearance of the greatest diversity of tongues has been produced. The degree of barbarism in which those wandering people, the Guamos, the Achaguas, and the Otomacks, were heretofore found, differs as much from that of the Macos, the Caracicanas, and the Maquiritaires, who are fixed to the soil, and given to cultivation, as their stature, and the colour of their skin (Vol. v. 567). The nations of the Upper-Oroonoko inhabit plains covered with forests, in the midst of which rise lofty mountains, but they are not, properly speaking, a mountainous people. Here, as on the tableland of Asia, conquering hordes issued from the steppes in the vicinity of the mountains and forests. The warlike and wandering Caribs have long been the masters and the scourge of those countries which they pass through to seize upon slaves. In their struggle with the Cabres, they were

the predominant nation of the Lower Oroonoko, as were the Guaypunabis, enemies of the Manivitains, between the Atabapo, the Cassiquiare and the Rio Negro, (Vol. v. 204, 208). The idioms of conquering nations have been generalized, and have survived the national preponderance; where they have not been substituted altogether for the native languages, they have left insulated words on their passage, which have been mixed, incorporated, *agglomerated* to languages entirely different. Those words, recognized by the dissimilarity of the sounds, are in barbarous countries the sole monuments of the antique revolutions of the human race. They have often a singular form, and in a country destitute of traditions, present themselves to the imagination like the vestiges of the animals of the primitive world, and which buried in the earth, are in contrast with the forms of the animals of our days.

European civilization, like all foreign and *imported* civilization, ascends the rivers, which native civilization descends, as is proved by the history of the people of Indus, the Ganges, the Euphrates, perhaps even the Nile. It cannot be doubted that anterior the barbarous hordes which now inhabit the forests of Guyana, those countries were peopled by another race more advanced in civilization, and who had covered the rocks with symbolic traces. Those painted rocks form a particular zone between the Atabapo and the Cassiquiare, the sources of the Essequibo and the Rio Branco, the Uruana and Cabruta, where the Tamanaque traditions on the deluge of Amalivaca are connected with the sculptured figures in granite. (Vol. v. 600). In the torrid as well as in the temperate zone, on the east of the Andes, as on the east of the Rocky Mountains, in that long series of nations which have successively inundated the plains, a feeble gleam of civilization had preceded the barbarism that existed when the European colonists passed over the Alleghanics, and along the banks of the Lower Oroonoko. Walls of a pro-

digious length, constructed of stone or earth, in the United States, denote the existence of populous towns, or of fortified camps and places at the confluence of great rivers. Notwithstanding the illusions of Raleigh and Keymis, no traces have hitherto been discovered in Guyana of an edifice in stone. Had the nations of the Oronoko remained abandoned to themselves, the civilization of Peru and the table-land of New Grenada, and that of the empires of the Inca and the Zaque would have penetrated towards the east, following the course of the Caqueta, the Rio Negro, and the Meta (Vol. v, 809, 838, 839.) ; but this movement of native cultivation would have been slower than that of foreign.

I am not ignorant that languages which have no literature are pretty generally considered with disdain ; (*inculti sermonis horrorem*) those sounds appear to us but the wild cry of nature, because our ear is not formed to seize the gradations ; but we must not forget that there is another view in which languages should be studied than that of collecting the individualities of a foreign literature.

The most uncultivated tongues are interesting with respect to their structure and interior organization. The botanist scarcely gives any preference to the plants which can be employed usefully in the arts, or which augment national wealth ; he seeks to analyse all the forms of the vegetable kingdom, because to apprehend properly the organization of one, he must know them all. In the same manner, we cannot reduce the tongues into families, without studying a great number of those that differ in their grammatical structure. If the multiplicity of languages existing on a small space, opposes great obstacles to the communication of different tribes, it gives them the advantage of preserving a character of individuality, without which all that belongs to national physiognomy is effaced. Besides, and I dwell with pleasure on this circumstance, none of the American tongues are in that

state of barbarism which has long been erroneously believed to characterize the infancy of nations; all have fixed grammatical forms, for the parts essentially organic in an idiom are formed at the same time. (William de Humboldt, on the progressive development of languages, in the *Memoirs de l'Académie Royale de Prusse*, 1823.) The further we penetrate into the structure of a great number of idioms, the more we distrust the great divisions of tongues (by bifurcation) into synthetic and analytic. These classes, somewhat like the great divisions of organized bodies, present a deceitful simplicity, to which the naturalist begins to substitute a distribution by small numerous groupes, connected as if interwoven together. To ask if this multiplicity of idioms is primitive, or the effect of progressive deviation, is to enquire if that variety of plants that embellish the earth has always existed, or if (according to the hypothesis of the great naturalist of Upsal) the species have been diversified by mutual fecundation. Questions of this kind do not belong to history, but to the cosmogonic fables of nations.



NOTE D.

The following are the very incomplete statements which have been hitherto obtained on the population of the ancient vice-royalty of Buenos Ayres, designated, under the government of the mother country, by the name of *Provincias del Rio de la Plata*, and divided into intendancies and governments, (Buenos Ayres, Montevideo, Paraguay, Salta del Tucuman,

Cordova del Tucuman, Charcas, La Paz, Potosi, Santa-Cruz de la Sierra, Chiquitos, and Moxos) :

I. AUDIENCIA DE BUENOS-AYRES.

Political divisions.

| | Population, not comprehend- ing the Indians. | Indians only. | Total Population. |
|--|--|------------------|----------------------|
| Buenos Ayres | 120,000 | 130,000 | 250,000 |
| Cordova | 75,000 | 25,000 | 100,000 |
| Tucuman | 60,000 | | |
| Salta (with the Vale de Catamarca and Jujuy) | 60,000 | | |
| Cuyo (Mendoza and S. Juan de la Frontera) | 75,000 | | |
| Paraguay and Missions... | 140,000 | | |
| Santa Fe, between Rios and Banda Oriental ... | 50,000 | | |
| Districts not estimated ... | 75,000 | | |

Total.655,000

(See Brackenridge, *Voyage to South America*, 1820, vol. ii. p. 47. Mr. Rodney, by different calculations, finds either 489,000, or 523,000. *Message to the fifteenth Congress*, 1818, p. 54.)

II. AUDIENCIA OF CHARCAS.

Political divisions.

Intendence of Charcas.

Charcas (La Plata or Chu-

| | | | |
|-----------------|--------|--------|--------|
| quisaca) | 16,000 | | 16,000 |
| Zinti | 25,000 | 35,000 | 60,000 |
| Yamparaes | 12,000 | 28,000 | 40,000 |
| Tomina..... | 12,000 | 28,000 | 40,000 |
| Paria..... | 13,000 | 37,000 | 50,000 |
| Oruro | 6,000 | 9,000 | 15,000 |
| Carangas | 8,000 | 17,000 | 25,000 |

92,000 154,000 246,000

| | Population, not comprehend- ing the Indians. | Indians only. | Total Population |
|-------------------------------|--|------------------|---------------------|
| Intendancy of Potosi : | | | |
| Potosi | 14,000 | 21,000 | 35,000 |
| Atacama | 8,000 | 22,000 | 30,000 |
| Lipes | 8,000 | 12,000 | 20,000 |
| Porco | 15,000 | 115,000 | 130,000 |
| Chayanta | 40,000 | 60,000 | 100,000 |
| | <hr/> | <hr/> | <hr/> |
| | 85,000 | 230,000 | 315,000 |

| | | | |
|-------------------------------|---------|---------|---------|
| Intendancy of la Paz : | | | |
| La Paz | 14,000 | 26,000 | 40,000 |
| Pacajes | 60,000 | 30,000 | 90,000 |
| Sicasica..... | 20,000 | 40,000 | 60,000 |
| Chulumani | 15,000 | 35,000 | 50,000 |
| Omasuyos..... | 30,000 | 30,000 | 60,000 |
| Larecaja | 25,000 | 40,000 | 65,000 |
| Apolobamba..... | 5,000 | 30,000 | 35,000 |
| | <hr/> | <hr/> | <hr/> |
| | 169,000 | 231,000 | 400,000 |

| | | | |
|---|---------|---------|---------|
| Intendancy of Cochabamba : | | | |
| Cochabamba..... | 30,000 | 70,000 | 100,000 |
| Sacaba | 15,000 | 45,000 | 60,000 |
| Tapacari | 30,000 | 70,000 | 100,000 |
| Arque ... | 10,000 | 25,000 | 35,000 |
| Palca..... | 6,000 | 14,000 | 20,000 |
| Clissa | 35,000 | 66,000 | 100,000 |
| Mizque | 8,000 | 12,000 | 20,000 |
| Valle Grande (Jesus de Montes Claros)..... | 3,000 | 70,000 | 100,000 |
| | <hr/> | <hr/> | <hr/> |
| | 164,000 | 371,000 | 535,000 |

Santa-Cruz de la Sierra,
Moxos et Chiquitos..... 220,000

(Brackenridge, vol. ii. p. 80.) I have rectified the names
of the provinces.

PRINCIPAL TOWNS, in the Audiencia of Buenos Ayres ; Buenos Ayres 60,000 ; Montevideo 7000 ; San Miguel de Cordova 6000 ; Santa Fe 6000 ; Tucuman 5000 ; Salta 6000 ; Mendoza 8000 ; Asumpcion 12,000 ; La Candearia 5000. In the audiencia of Charcas : La Paz 40,000 ; Potosi 85,000 ; La Plata 16,000 ; Oruro 15,000 ; Zinti 12,000 ; Oropesa 25,000 ; Zarate 12,000.

These estimates of the population are incomplete for the lower regions of the Audiencia of Buenos Ayres ; for instance, for Salta, Sante Fe, Banda oriental and Entre Rios, the calculation is perhaps too low ; it amounts from the years 1817 to 1820, for the Audiencia of Charcas, with Santa Cruz, Moxos, and Chiquitos to 1,716,000, comprehending the natives ; for the Audiencia of Buenos Ayres, *without the Indians*, 655,000, total 2,371,000. M. Schmidtmeier, in his interesting *Voyage to Chili*, reckons 1,100,000 inhabitants for the basin of La Plata, and 1,300,000 for the *provincias de la Sierra*. It appears to me probable that before the revolution, the white, copper-coloured, and mixed population of the whole vice-royalty, previously to the dismembering of the Cisplatine province by the Brazilian Portuguese, and of Paraguay by Doctor Franzia, exceeded $2\frac{1}{2}$ millions, of whom 1,200,000 were Indians.

NOTE E.

The rapid increase of the population of the United States has been the basis of so many calculations of political economy in Europe, that it becomes highly interesting to know with precision the principal statements. In order to compare the numbers, and fix them with exactness, we must have recourse to the first sources, that is, to the tables printed by the Congress, and cleared of the typographical errors by which they are sometimes disfigured. The population of 1800, which was 5,306,032, is stated by Mr. Mellish (*Travels*, p. 566), at 5,308,844; by Mr. Seybert (*Statist. Annals*, p. 72), at 5,319,762; by Mr. Harvey (*Edin. Phil. Journ.* 1823, p. 42), at 5,309,758. I shall here transcribe a note, which I owe to the kindness of M. Gallatin, who long occupied the place of minister of the public treasure at Washington, and whose departure from Europe has recently caused so much regret to those who know how to appreciate talents, and generous sentiments.

“ The exactness of the following official information may be depended on :

| | 1790. | 1800. | 1810. | 1820. | | |
|-------------|-----------|-----------|-----------|-----------|--|-----------|
| Whites..... | 3,172,120 | 4,303,133 | 5,862,093 | 7,862,282 | Under the name of <i>blacks</i> is comprehended also the copper-coloured people, of which the number is very small in the United States. | |
| Blacks { | Free . | 59,511 | 109,294 | 186,443 | | 238,149 |
| | Slaves | 697,697 | 893,605 | 1,191,367 | | 1,537,568 |
| Total .. | 3,929,328 | 5,306,032 | 7,239,903 | 9,637,999 | | |

“There are several observations to be made in calculating the increase for every period of ten years.

“1st. The inhabitants of the countries situated on the north of the Ohio, (States of the Ohio, Indiana, and the Illinois, and the territory of Michigan), and also the inhabitants of the territory forming at present the state of Mississippi, were not numbered in 1790, and they ought to be added to the enumeration of that year. I calculate that they were at that period :

| | | |
|-------------------|--------|----------|
| Whites | 10,000 | } 11,800 |
| Free Blacks | 200 | |
| Slaves | 1,600 | |

“2dly, Three counties of the state of Alabama have been omitted in the estimate of 1820, but it is known that they contained more than 12,000 inhabitants, of which nearly 8000 were whites, 4000 slaves, and 50 free blacks.

“3dly, Louisiana having been acquired only in 1803, could not be comprehended in the enumerations of 1790 and 1800. According to the enumerations made in 1799-1802 by the Spanish government, the population of Louisiana was in 1800;

| | Lower Louisiana, at present <i>Louisiana.</i> | Arkansa. | Upper Louisiana, at present <i>Missouri.</i> | Total. | |
|-------------|--|----------|---|--------|--|
| Whites..... | 18,850 | 350 | 5,000 | 24,200 | This number must be added to the enu- meration of 1800, when we calculate the increase from 1800 to 1810. |
| Blacks { | Free... 2,300 | — | 200 | 2,500 | |
| | Slaves . 18,850 | 50 | 9 | 19,800 | |
| Total..... | 40,000 | 400 | 6,100 | 46,500 | |

" 4thly, In order to calculate the *actual* increase, we must include, not only the acquisition of Louisiana, but also the emigrations from Europe. With respect to the white population, we may, I think, assert, that the annual mean of the emigrants arriving in the United States is nearly 10,000, or rather between 7,000 and 14,000; for although there have been years of 22,000 and of 5,000, the average of the emigration from Europe is not above 14,000, nor below 7000. The increase of the black population is entirely natural, with the exception of the period from 1800 to 1810, during which we must include, not only the number of blacks found in Louisiana, but also nearly 39,000 Africans, imported during the years 1804 to 1807, the period to which South Carolina permitted the importation of slaves. We should always consider in these calculations the whole of the black population, free and enslaved.

" Although we have not yet sufficient statements to obtain definitive results on the annual births and deaths, it may be affirmed that for the white population, the former are below five, and the latter below two, in an hundred. The natural annual difference or increase is 2·0 in an hundred."

I shall add to the above information given by Mr. Gallatin, some other numerical statements :

The *total population* in 1810, was 7,239,903; in 1820 it was 9,637,999; increase 33 p. cent.

The *white population*, in 1810, was 5,862,093; in 1820 it was 7,856,082; increase 34 p. cent.

The *slave population*, in 1810, was 1,191,364; in 1820 it was 1,537,568; increase 28 p. cent.

The population of free coloured people, in 1810, was 186,443; in 1820 it was 238,149, increase of 27½ p. cent.

The calculation of the *area* of the United States, which I gave above, in Chapter xxvi, supposes the astronomical verification of five great lines; those of the coast of the

Atlantic, the Alleghany Mountains, the course of the Mississippi, the Rocky Mountains, and the coasts of the South Sea that divide the confederation into four natural sections. I the general maps that have hitherto been traced, had no other errors than those of *absolute* longitude, and in preserving the differences of *relative* longitude, they displaced equally with regard to Europe (for instance to the meridians of Paris or Greenwich), the five great lines we have just named, the *area* of the partial divisions would not be altered. In order to estimate the effects of these unequal displacings, I have compared on every map used for the calculation of surfaces, the longitude of New York, Pittsburg, the confluence of the Ohio and the Mississippi, and of Taos, a village of New Mexico, situated, so to speak, on the prolongation of the Rocky Mountains, and the bay of Nootka. The three first points are founded on the excellent observations of M. Ferrer. New York is $8^{\circ} 22' 34''$ east of Morro of the Havannah, and this point being $84^{\circ} 42' 33''$ by my observations of the satellites, and according to the occultations of M. Ferrer, $84^{\circ} 42' 43''$ west of Paris, we may admit, for the absolute longitude of New York, $76^{\circ} 20' 9''$. (*Conn. des temps*, 1817, p. 320 and 339; and my *Astr. Obs.* Vol. 2, p. 108). The well determined longitudes of Pittsburg ($82^{\circ} 18' 30''$), of Albany ($76^{\circ} 4' 45''$), and of Lancaster ($78^{\circ} 39' 30''$) serve, by the proximity of those three points to the mountains, to contain within just limits the chain of the Alleghanies. The line of the Mississippi is fixed by observations made at the mouth of the Ohio ($91^{\circ} 22' 45''$), and at New Orleans ($92^{\circ} 26' 15''$). The chain of the Rocky Mountains which divides the country west of the Mississippi into two great sections, is not yet so accurately determined as to its longitude as the three preceding lines. I suppose Taos of New Mexico at $106^{\circ} 50'$; Lewis and Clarke place the central chain of the mountains in the parallel 45° , at $114^{\circ} 46'$; but

this position is probably far too much to the west, although the parallel chains of the Rocky Mountains fill a space of more than 3° of longitude, in this parallel. The coast of the Pacific Ocean has been surveyed with the greatest care by Vancouver, Galiano, and Valdes; the *relative longitudes* leave little to desire, but the *absolute longitudes* remain in uncertainty more than half a degree. According to the learned researches of Mr. Oltmanns, the Nook of the Friends at the isle of Nootka is probably 128. 57'; but the partial results of Galiano (8^h 35' 40"), Marchand (8^h 35' 44"), Cook (8^h 36' 10") and of Vaucouver (8^h 36' 55'), are not in the accordance we might have hoped from the concurrence of so many chronometers, and such a series of lunar distances. (*Sse my Obs. astron.* Tom. ii, p. 596, and *Oltmans, Geogr. Untersuchungen*, Tom. ii, p. 439).

The five great lines of demarcation which we have just discussed, divide the immense territory of the United States into four unequal parts :

α) *Between the Atlantic coast and the Alleghanies*, in supposing those mountains prolonged on the north; towards Plattsburg, and on the south, by following the banks of the Apalachicola. According to this prolongation, proposed by Mr. Gallatin in a very interesting memoir which he permitted me to insert in the Political Essay on New Spain, (Vol. iv. p. 324), the gretest part of Florida is comprehended in this first division, the *area* of which I found to be at least 324,000 square English miles, or 27,064 square marine leagues. I calculated separately the portion of the *Atlantic States* that falls on the west of the Alleghany Mountains, those mountains crossing the states of New York, Pennsylvania, Virginia, and North Carolina. The extent of country which we must deduct from the total territory of the *Atlantic States*, comprehending West Florida, is 97,071 square miles. In dividing the 324,000 square miles of the first division in the

north-east States (from the Delawar to the Maine), and in the south-east states (from Maryland to Florida), we find for the former 110,991 square miles; and for the latter 213,009 square miles. The *Atlantic Slave-States* (states with slaves situated on the east of the Alleghanies) exceed a little the *area* of France. The whole of Florida contains, according to my calculations, 59,187 square miles, of which 52,310 are on the east of Apalachicola, and 6,877 on the west of that river. MM. Carcy and Lea estimate Florida at 57,750 square miles. The division of Alleghanies into several parallel chains renders the partition of the United States situated on the left bank of the Mississippi, a little arbitrary, in two portions, on the east and west of the mountains. The 15 *Atlantic States* (from Georgia to the Maine, consequently without the Floridas) occupy, on the two sides of the mountains, according to Mr. Warden, 386,000 square miles; according to Mr. Morse, 377,446, and according to M. Melish, 366,000. In adopting the latter number, and in estimating at $97,071 - 6,877 = 90,194$ square miles, the 15 states lying on the west of the Alleghanies, we find the territory of the United States comprehended between the Atlantic Ocean and the mountains, without Florida, to be 275,806 square miles, and with Florida, 328,116; which results agree with those I found from direct measures. Mr. Galatin, in 1804, estimated this division, without comprehending Florida, at 320,000 square miles, which seems to prove that this statesman, so well versed in the statistics of his country, had allowed more than 386,000 square miles, for the total *area* of the *Atlantic States*, or, that he had traced the line of division by a chain less easterly than the Alleghanies.

- β) *Between the Alleghanies and the Mississippi*, at most 606,000 square English miles, or 50,620 square marine leagues. I find, without that part of Florida situated on the west of

Apalachicola, 599,123 square miles. Mr. Gallatin had well estimated that surface at more than 580,000 square miles. If the partial value of the two sections α and β are affected by the uncertainty of a line of demarcation passing by one of the numerous chains of the Alleghanies, the total value of $\alpha + \beta$ remains less doubtful, because it depends only on the position of the coast of the Atlantic, that of the lakes, and the course of the Mississippi. The divisions of the United States into two great sections, on the east and west of the Mississippi, is, from its very nature, the most exact of all; and the maps which we possess at present, disagree only on account of the uncertain form of the peninsula of Florida, and the want of an accurate representation of the coast of Georgia, of Alabama, and of the territory of the Mississippi. Mr. Gallatin finds for the value of $\alpha + \beta$, comprehending Florida, 958,000 square miles; Mr. Warden, 909,000; Mr. Melish, 952,000. I have fixed on 930,000 square miles, or 77,700 square marine leagues; but Mr. Brué's map, for which several astronomic positions were employed, gives 972,000 square miles. All these calculations of the *area* prove, that the limits of the errors are in the actual state of the geography of America, between one twenty-sixth and one thirty-fifth. The errors even in Europe amount in many countries, to one-fortieth. (*Antillon, Geogr. p. 143*).

- γ) *Between the Mississippi and the Rocky Mountains*: 868,400 square miles, or 72,531 square leagues. As many doubts have been recently thrown out respecting the *area* of the territory of the Missouri, I have again made the calculation on a great number of maps; of which the result for the part of that territory between the Mississippi and the Rocky Mountains, comprehending the state of Missouri, is 693,862; 680,806; 692,277; 696,277 square miles. Mr.

Morse estimates this *area* much too high at 860,000 square miles. The territory of the Arkansas only, of a great part of which Major Long has taken very exact surveys, is 125,855 square miles. I found the state of Louisiana on the east of the Mississippi, 6200 square miles, and on the west 45,300.

§ *Between the Rocky Mountains and the coast of the Pacific Ocean*: 288,400 square miles, or 24,091 square marine leagues. This is the territory of Columbia, of Oregon or the west, which must not be confounded either with the *territory of the north-west*, between lake Superiour and lake Michigan, now comprehended in the territory of Michigan, nor with the English western territory, which the members of the North West Company pass over. I have found on different maps, for this fourth great division of the United States, 286,034 ; 288,391 ; 284,925 ; and 290,400 square English miles. The territory of Oregon (Columbia), Arkansas, and Missouri, comprehending the state of this latter name, furnishes, according to my calculation, an *area* of 1,107,000 square miles, an immense region, which in 1820 did not contain 83,000 inhabitants of European origin.

The United States, from the Atlantic to the Pacific Ocean, now comprehend an *area* of 174,306 square leagues, 20 to a degree, or 2,086,800 square miles. Mr. Morse computes the *area* at 2 millions of square miles, the half of which belongs to the territory of Missouri, Arkansas, and Oregon. M. Warden, in the French and English editions of his statistical work (Introd. Vol. i, p. xlix and li,) had estimated that surface at more than 1,636,000 square miles; and if he seems at a later period in the French edition (Vol. v, p. 100, and *Bulletin de la Société de Géographie*, vol. i, n° 3), to fix on 1,637,000, that diminution of surface arises only from an error caused by the reduction of leagues into square miles. The

territory comprehended between the Mississippi and the Pacific Ocean, does not contain 741,414 square miles (namely, the state of Louisiana, deducting what is eastward of the Mississippi, $48,200 - 9,215 = 39,005$; territory of Arkansas, 76,961; territory of the Missouri, 445,334; territory of the West, 180,114 (*Warden*, Vol. i, p. 101; Vol. iv, p. 563, 653); but 1,156,800 square miles. A well-informed geographer, whom Mr. Warden had employed in those calculations of surface, repeated them at my desire; and, in employing the real logarithms of reduction, found the territory of Missouri, comprehending the state of that name, nearly as I did, to be 696,000 square miles, instead of 445,334; the territory of the West, 284,000 square miles, instead of 180,114; and the territory of Arkansas, 125,855 square miles, instead of 76,961. These partial errors, which bear only on the most unpeopled part of the American territory, and from which the calculations of surface in the English edition of Mr. Warden's work are entirely exempt, produce a total difference of more than 400,000 square miles, or 33,400 square marine leagues. M. Adrien Balbi, who in his statistical essay on the kingdom of Portugal has collected a great number of precious materials for the study of political economy in general, computes the *area* of the United States (Vol. i, p. 259,) to be 2,146,000 Italian square miles, 60 to a degree (238,000 square marine leagues). This estimate is nearly one-fifth too great. On the other hand, the results fixed on by Mr. Morse, in a very instructive work just published at Boston, with the title *System of Modern Geography*, differ very little from mine for the eastern part of the confederation. He fixes the United States at 377,446 square miles; now, deducting 90,200 for the portion of those states lying west of the Alleghanies, and adding 52,300 for Florida, on the east of Apalachicola, we obtain, for the division α , 339,600 square miles. The eight states and territories situated between the Atlantic States and the Mississippi, comprehending

the eastern part of the state of Louisiana, are computed by Mr. Morse at 484,000 square miles ; and the whole division β (adding 90,200 + 6,900 for the portion of the *Atlantic States* and Florida, on the west of the Alleghanies), at 581,100 square miles. It thence results for $\alpha + \beta$, 920,700 square miles, only one ninety-fifth less than the area which I stated (see above, p. 179,) for the territory of the United States east of the Mississippi.

A surface of 2,086,800 square miles furnished to the industry of a laborious people wisely governed, is ten times larger than France. It need not be augmented by substituting, as some American engineers have seemed recently to desire (on occasion of the rectification of the limits of Canada), *geocentric latitudes* (the angle formed by the inclination of the earth with the equator) for ordinary latitudes. (*Quart. Journ. of Sciences*, 1823, Jan., p. 412.)

In comparing the *area* of the great divisions with the number of inhabitants which the enumeration of 1820 yields, we find :

- I. In the 15 Atlantic States (from Maine to Georgia), consequently without the Florida on both sides of the Alleghanies, on 30,900 square marine leagues, or 370,000 square English miles :

| | |
|---------------------------|-----------|
| Absolute population | 7,420,762 |
|---------------------------|-----------|

| | |
|--|-----|
| Relative population on the sq. mar. lea. | 239 |
|--|-----|

- II. Between the Atlantic States and the left bank of the Mississippi (also without Florida), on 42,000 square leagues.

| | |
|---------------------------|-----------|
| Absolute population | 1,982,998 |
|---------------------------|-----------|

| | |
|--|----|
| Relative population on the sq. mar. lea. | 47 |
|--|----|

- III. Between the right bank of the Mississippi and the coast of the Pacific Ocean, on 96,600 square leagues, or 1,156,000 square miles.

| | |
|--|-----------------|
| Absolute population, without the Indians | 234,239 |
| Relative population of the whites on the square league | 2 $\frac{1}{2}$ |

It results from these calculations, in which the errors in the estimate of surfaces can have no sensible influence on the relative population, that the United States on the east of the Mississippi (without comprehending the Floridas) contained in 1820, on an *area* of 77,700 square marine leagues, or 730,000 square English miles, an absolute population of 9,403,760, and a relative population of 122 inhabitants to the square marine league. If the relative population of the whole territory of the United States, from the Pacific to the Atlantic Ocean, was in 1820, 55 inhabitants to the square league, it must have been at the end of the year 1822, (when I find, in supposing an uniform increase, a total population of 10,220,800), a little above 58. The immense augmentation of the population on the east of the Mississippi becomes little sensible if, according to a simply mathematical abstraction, we divide the whole population over the entire surface of the territory.

I have discussed in this note the uncertainty that hangs over objects of the highest interest in political economy ; I have particularly fixed my attention on the countries situated on the west of the Mississippi, and of which the destiny will in the lapse of ages have a powerful influence on the state of the northern provinces of Mexico. In order to obtain an accurate knowledge of the *area* of the United States, we need not wait for the period when 174,000 square leagues are trigonometrically surveyed. It is by means simply astronomical, by the combination of a great number of observed latitudes, and *chronometrical lines* traced in different directions, that we can rapidly obtain precise statements, indispensable in every good administration. Amidst so much uncertainty, it were to be wished that the Congress of Wash-

ington would collect the materials already obtained, in order to fix by calculation, I do not say the *area* of every state and every territory, but the total *area* of the four great natural divisions comprehended between the coast of the Atlantic Ocean, the central chain of the Alleghanies, the course of the Mississippi, the Rocky Mountains, and the Pacific Ocean.

The population in the English possessions in the neighbourhood of the United States, is now perhaps one-seventh greater than I supposed, in the table p. 142. It was computed in 1814, in Lower Canada, 335,000 ; in Upper Canada, 95,000 ; in New Scotland, 100,000 ; in New Brunswick, 60,000 ; in Newfoundland and at Cape Breton, 18,000 ; in all, 608,000 inhabitants. (*Carey and Lea, Historical, Chronological, and Geographical Atlas of America, 1822, N° 4.*)

In order to facilitate the reductions of surfaces, we shall here repeat that a square marine league (20 to a degree), is 11·9716 English square miles (of 69·2 to a degree), or 1·5625 square French leagues (25 to a degree), or 0·5625 geographical square leagues (15 to a degree), or 9 Italian square miles (60 to a degree).



NOTE F.

OCCUPIED by astronomical determinations on the southern frontier of the Spanish Guyanas, I had great interest, during my travels, in collecting all that has any relation to the disputes concerning the limits between the crowns of Portugal and Spain. This information was necessary in order to complete the memoir I addressed on my return from the Oroonoko, to the first secretary of state, Don Mariano Luis de Urquijo (See above, Vol. v, p. 299, 413 ; Vol. vi, p. 351).

Without pretending to give a complete history of these *Commissions of boundaries*, which the ignoble artifices of European diplomacy have prevented from being more useful to the astronomical geography of the New Continent, I shall here succinctly publish the ideas which may throw light on that question ; and of which those that relate to the negotiations of the 18th century, are taken from unpublished pieces preserved in the archives.

The discussions concerning the boundaries between the courts of Madrid and Portugal, have lasted during three centuries. They at first touched only on maritime interests, the possession of islands and coasts ; by degrees they have extended to the interior of South America. The celebrated bull of pope Alexander 6th (May 4th, 1493) in favor of Spain, was made in the same spirit as the less known bull of the year 1445, issued by pope Nicolas 5th in favor of Portugal. The former places the line of demarcation an hundred leagues east of the Islands of Azores and Cape Vert, and gives to the Spaniards all that on the west of that line had not been occupied before Christmas in the year 1492. It says confusedly enough, *centum leucas a qualibet insularum quæ vulgariter nuncupantur de las Azores y Cabo Verde*. Cardinal Bembo, who, in his classical style, proscribes all new denominations, simply says, *Gorgonum insulæ*, no doubt (*Pliny* according to *Xenophon de Lampsaco*, lib. 6, c. 31, *Meta*, lib. 3, c. 9,) the *Gorgades* (*domus, ut aiunt, aliquando Gorgonum*) opposite the *Byssadium Promontarium*. The island of Saint Anthony is, no doubt, in the meridian of the island of San Michael, but there are 8° of longitude from the meridian of the most western island to the meridian of the most eastern of the Azores. A new bull of the 24th November, 1493, leaves the same doubts ; but in the treaty of Tordesillas (June 7, 1494), the meridian of the demarcation was carried to 370 leagues, instead of 100, from the Cape Vert islands. The measure of the leagues not having been indicated, the

linea divisoria reaches, according to different hypotheses, the mouth of the Rio Francisco, or Rio Janeiro, or the meridian of Saint Paul, which is still placed 1° to the east of Grand Para. Pope Julian sanctioned the treaty of Tordesillas by a bull issued January 24th, 1506; but the daring voyage of Magellan, and the discoveries (1500—1504) of the mouth of the river Amazon, by Vicente Janez Pinson, of Cape San Augustin, by Amerigo Vespucci, and the ports of Santa Cruz and of the Bahia of Todos Santos, which had preceded that voyage, engaged the courts of Madrid and Lisbon to assemble in 1524, the *congress of pilots and cosmographers* at the bridge of Rio Caya, between Yelves and Badajoz. The Spaniards accused the Portuguese of having altered the distance from Gilolo to the coast of Brazil, and prove victoriously that the Moluccas belonged to the Castillian domains. The celebrated mathematician Faleiro, had taught the pilots the lunar methods by which they might determine the distance of a ship from the line of demarcation, considered as a first meridian. This line contributed no doubt powerfully to the ardor with which at that period the proper methods were sought, of finding the longitude by precise means. The congress of cosmographers at *Puente de Caya* went on slowly, and the disputes between the two nations respecting the possessions of the archipelago of India, only concluded by a treaty at Saragossa, the 22d of April, 1529. (*Don Juan y don Antonio de Ulloa, Dissert. historica y geographica sobre el meridiano de demarcacion. Madrid, 1749, Salazar de los progresos de la hydrografia en España, 1809, p. 115. Cespades, Hydrografia, cap. 4, p. 128, 143, 152.*) Spain ceded the Moluccas for the sum of 350,000 ducats, reserving the right of again possessing itself of the property of those islands whenever the amount of the purchase should be returned. The union of the two crowns under Philip 2d, calmed for some time national hatred, or rather compelled it to appear to be appeased; but from the end of the 17th

century, the establishment of *la Colonia de San Sacramento*, near the mouth of the Rio de la Plata, gave rise to disputes respecting the Brazilian limits. The Spaniards destroyed this settlement, and a new congress of cosmographers assembled at *Puente de Caya*, which lasted from the 4th of November [1681], to the 22d of January, 1682. It had been stipulated at the beginning of the negociations, that if they were not settled in the space of three months, they *should be submitted to the decision of the Sovereign Pontiff*. When we consider the state of the world an hundred years before the declaration of independence of the United States, we are tempted to doubt what is proved by the most authentic documents preserved in the archives. It was uselessly discussed, whether the 370 leagues mentioned in the treaty of Tordesillas, formed $22^{\circ} 14'$, or a less number of degrees, and whether that distance ought to be reckoned in the archipelago of Cape Vert, from the centre of the island of Saint Nicolas, or (as the Portuguese insisted), from the western extremity of the island of Saint Anthony. According to these detached arguments, the cosmographers of Lisbon sought to carry the *meridiano de demarcacion* 13 leagues west of the reconstructed settlement of San Sacramento. The congress of *la Puente de Caya* separated without having decided any thing, and the points in litigation were not submitted to the sovereign Pontiff as had been agreed. During the feeble reign of Charles 2d, the Portuguese gained every where upon their neighbours in America, on the side of Paraguay, on the banks of the Amazon, and on the Rio Negro. By the peace of Utrecht, Spain renounced the possession of San Sacramento. Nearly forty years passed in the most complete inactivity on the part of the ministry of Madrid, when Queen Barbara, daughter of John 5th of Portugal, sought to avail herself of the extreme weakness of her husband Ferdinand 6th, king of Spain, in order to be useful to her country, and terminate the struggle respecting the limits in South

America, in favor of the court of Lisbon. The chief of a squadron, Don Josef de Yturiaga, was named director (*primer commissario*), of an expedition intended to sail along the northern frontier of the *Capitania general* of Grand Para, enter the Amazon by the Oroonoko and the Rio Negro, and go up the Amazon as far as the province of Maynas, and perhaps even pass by land to the confines of Paraguay. (See the correspondence of Loefting with Linnæus, in *Jotri Loeftingi Her Hispanicum eller Resa, til Spansza Länderna uti Europa och America*, 1758, p. 84—90). The expedition set sail from Cadiz, February 15th, 1754, having on board a chemist, a naturalist, and a geographer. The naturalist was the celebrated Loefting, who, after having examined the country round Cumana and Nueva Barcelona, the missions of Piritu and Caroni, died the victim of his zeal, at Santa Eulalia de Murucuri, (Linnæus calls this village Merecuri, Surville, Mucururi,) a little to the south of the confluence of the Oroonoko with the Rio Caroni, the 22d of February, 1756. Eturiago made the necessary preparations for the projected navigation on those rivers, in the island of Trinidad. He entered the mouth of the Oroonoko, at the end of July, 1754, with 53 small craft. (*Golitas, Lanchas, Piroguas, and Changuanas.*) Dysenteries and fevers made great ravages among the troops, and even several hundred Indians fell sick. The fortress of la Vieja Guyana could only be reached on the fifteenth day. (See above, vol. v, p. 756 and 831, &c.) They went up no less slowly as far as Cabruta, near the mouth of the Rio Apure. Several barks imprudently exposed to the sun on the beach, split; the fevers continued, and rowers (*bogas*), boats, and money were at the same time wanting. Two of the commissaries, Don Eusebio de Albarada, and Don Joseph Solano, went to Santa Fe de Bogota in search of funds; they came back after six months' absence, in 1756. Solano alone, with a small part of the expedition, passed over the great cataracts of Atures and May-

pures. He did not go further than the mouth of the Rio Guaviare, where he founded San Fernando del Atebago (Vol. v, p. 210, 299, 525, 846, and MS. of *Don Apollinario Diez de la Fuente*, which I took from the archives of the province of Quixos, south east of Quito). We have already shewn in another place, that the astronomical instruments of the *expedition of the boundaries*, were neither carried to the isthmus of Pimichin, to the Rio Negro, to the Cassiquiare, or the Alto Oroonoko, above its confluence with the Guaviare and the Atabapo. This vast country, in which no precise observation had been attempted before my journey, had at that time been visited only by some soldiers who were sent by Solano on discovery, and by Don Apollinario de la Fuente. He constructed a small fort with trunks of trees at the point of the bifurcation of the Oroonoko, entered the Rio Padamo to visit the Catarapene Indians, and founded the mission of the Esmeralda, with the Maquiritares, from whence he made a fruitless excursion towards the Rio Gehette, and the Cerro Yumariquin (Vol. v, p. 575, 582). Don Apollinario, whose name I have often heard pronounced by the Indians of Rio Negro, and the Esmeralda, affirms, in his journal preserved at Quito, that at the departure of the expedition of Solano (1754), consequently ten years after the voyage of Father Roman (Vol. v, p. 488, &c.), many persons in the island of Trinidad still doubted of the communication of the Oroonoko with the Amazon, and that they had no precise idea of the existence of the Cassiquiare, and of its junction with the Rio Negro.

While Don Josef Solano made efforts to pacify the Upper Guyana, Yturiaga remained on the banks of the Lower Oroonoko. This chief of the *Commission of the boundaries*, had, it is asserted, secret orders to prevent any definitive conclusion of a treaty. He wished to please the minister of the Indies, Areiaga, and above all, the successor to the crown of Spain, Don Carlos, who reigned at Naples. That prince

could not openly oppose the projects of his mother Queen Barbara, and the Portuguese party; the treaty, it was known, would be hostile to the interests of Spain, and all that remained was to gain time in creating obstacles. The craft constructed to convey the remainder of the troops beyond the cataracts, on the frontier of the Capitanía general of Grand Para, were ready to sail, and the orders of King Ferdinand the 6th were precise. Yturiaga caused a *Te Deum* to be sung at Muitaco (Vol. v, p. 689, &c.) and during the ceremony, set fire clandestinely to the fleet, which was said to have been burnt accidentally. But so little pains had been taken to conceal this stratagem, that it was instantly discovered. The Portuguese commissaries offered to send their own boats for Yturiaga, but he answered that he would wait for orders from Madrid. Ferdinand 6th, wearied of the expence and the delays of Yturiaga, recalled the expedition. Solano and Albarados embarked, I believe in 1761, at La Guayra, for San Sebastian. Yturiaga, after having long inhabited the small town of Muitaco, where he hoped to re-establish his health, died at the island of Marguerita. The complaints made against him by the monks, and by his colleagues the other commissaries of the boundaries, embittered the latter part of his life. Don Apollinario Diez de la Fuente returned from Spain to the Oroonoko with the pompous titles of *Capitan poblador del Alto-Orinoco y Cabo militar del Fuerte de Cassiquiare*; he was afterwards made governor of the province of Quixos, and *Cosmografo de la real Expedicion de limites del Marañon*. If we may judge from his manuscripts, the cosmographers assembled at the congress of Puente de Caya, in 1524, were better informed than this emissary.

The labors of the commission of the boundaries of the Oroonoko which I have just related, were also as fruitless as the treaty signed January 12th, 1750, at Madrid, by which the Portuguese and Spanish nations re-

nounced the line of demarcation, and promised to recognize no other limits between Brazil, Buenos Ayres, and Peru, than the ridge of some mountains, and the course of the rivers. This convention declared formally "that it was impossible to fix by observations of longitude the line of demarcation on the coast, and in the interior;" a confession the more singular, as Don Jorge Juan, and Don Antonio de Ulloa, had proved, in a learned memoir (*Dissertacion historica y geografica sobre el meridiano de demarcacion entre los dominios de Portugal y de España*), published after their return from Quito, in 1749, that the limit ought to be fixed by the tenor of the treaty of Tordesillas, and according to two modes of interpretation of which that treaty is susceptible, either $1^{\circ} 50'$, or $3^{\circ} 14'$, on the east of the town of Grand Para. The convention of 1750 was renewed and confirmed at Madrid, October 11th, 1777; but the execution of stipulations made without local knowledge, and in consulting only very imperfect maps, was attended with greater difficulties. Nothing more was attempted on the side of the Oroonoko, and the Rio Negro; the whole attention of the two courts was directed towards the limits of Paraguay, and the banks of the Caqueta, the Rio Blanco, and the Amazon. The Brigadier Don Jose Varela, was sent (1782—1789) to Montevideo, M. d'Azara to Paraguay, and M. Requeña to Maynas. However incomplete the labours of the commissaries have remained, it cannot be doubted that astronomical geography will derive great advantages, if not the results only of their investigation are made public, but the observations on which those results are founded. The map by Azara of Paraguay, and those of Brazil, executed at Rio Janeiro, by order of the minister of marine, Don Rodrigo de Souza Coutinho, in 1804, by the captain of a frigate, Don Antonio Pères da Silva Pontes Lemos, have been rectified according to a part of those observations; but the longitudes being all chronometrical, the discordance in the time pieces of the Spanish

and Portuguese geographers, and the uncertainty of the positions which served as points of departure, threw great confusion on this determination of the boundaries. The court of Madrid, wearied of the expence and delay, dissolved the commission in 1801 ; and some years afterwards, the military occupation of the cisplatine province by the Portuguese, put an end for a long time to the discussions respecting the longitude, and the dilatory exceptions of diplomacy.

NOTE G.

IN making known to the learned of Europe the physical properties of the *cow-tree* (see above, Vol. iv, p. 212, 226, 261 ; Vol. vi, p. 211), I had compared its nourishing milk, not with the juice of plants that abound in caoutchouc, like the juice of the Hevea, but with the milk of the Papayer. I had tried some chemical experiments on the latter, which appeared to me a strongly animalized substance. Two of my friends, MM. Boussingault and Rivero, whose important labours I have already had occasion to mention (Vol. vi, p. 219, and 253), and who are much better versed in chemistry than I was at the period of my voyage, have recently made the chemical composition of the juice of the *Palo de Vaca*, completely known. The following is an extract of the analysis sent to me by those chemists in a letter from Maracay (between Caraccas and Nueva Valencia), dated February 13th, 1823.

“ The milk,” says M. Boussingault, “ which we have animalized at your desire, is produced by the *Palo de Leche*, or the *Vaca*. This tree grows in abundance on the mountains that command Perequito, situated north-west of Maracay. This vegetable milk possesses the same physical properties as that of the cow, with this difference only that it is a little more slimy. It has also the same taste, but its chemical proper-

ties differ sensibly from those of animal milk. It can be mixed with any proportion of water, and, in that state, does not coagulate by ebullition, nor is it curdled by acids, like the milk of the cow. Instead of being precipitated by ammoniac, it is rendered more liquid, and this character indicates the absence of caoutchouc ; for we have observed that in the juices containing this principle, ammoniac precipitated the smallest quantity, which when dried, possessed the properties of elastic gum. Alcohol slightly coagulates the milk of the cow-tree : it is something less than a coagulum, for the alcohol only renders it more difficult to filtrate the juice. The new milk lightly reddens the heliotrope ; it boils at the temperature of 100° , and at the pressure 0^m 729. Undergoing the action of heat, it presents at first the same phenomena as the milk of the cow ; a pellicula forms on its surface, which prevents the disengagement of the aqueous vapours. In raising successively the pellicula, and making it evaporate at a mild heat, an extract is obtained resembling a kind of paste ; but if the action of heat is longer continued, oily drops are formed which augment in proportion as the water is disengaged, and end by composing an oily liquid, in which swims a fibrous substance that dries and hardens as the temperature of the oil augments, and spreads a smell like that of fried meat. Vegetable milk is separated by the action of heat into two parts ; one fusible, of a sacculent nature, the other fibrous, of an animal nature. If the evaporation of the vegetable milk is not carried too far, and the fusible matter is not boiled, it may be obtained without alteration. It has the following properties ; it is of a yellowish white, translucent, solid, and resists the impression of the finger ; it begins to melt at 40° centigr. ; and, when the fusion is complete, the thermometer indicates 60° . It cannot be dissolved in water, but is dissolved easily in essential oils ; with which it also combines, and forms a composition analogous to cerat ; alcohol at 40° , dissolves it totally by

ebullition, and it is precipitated by cooling ; it is *saponifiable* by caustic potash ; and, when put into ebullition with ammoniac, forms a soapy emulsion. It is dissolved by hot nitric acid, with a disengagement of nitrous gas, and forms oxalic acid. This matter appears to us to resemble hot bees-wax, and it may serve for the same use, for we made it into wax candles.

“ We obtained the fibrous matter by evaporating the milk, pouring off the melted wax, washing the residue with an essential oil to carry off the last portions of wax, pressing the residue, and making it boil for a long time with water in order to volatize the essential oil. Notwithstanding this operation, the smell of the essential oil cannot be altogether taken away. The fibrous matter thus obtained is brown, because it is no doubt somewhat altered by the high temperature of the melted wax ; it has no taste, and put on a hot iron, turns, swells up, melts, and is carbonized, spreading a smell of broiled meat. If treated with a diluted nitric acid, a gas is disengaged from it which is not nitrous gas ; the fibrous matter is transformed into a fat yellow mass in the same manner as muscular flesh, when azote gas is prepared by the process of M. Bertholet. The alcohol does not dissolve the fibrous matter, and we have employed that liquid to obtain it without alteration. In treating the extract of vegetable milk by the reiterated action of spirits of wine, and pouring off the hot liquor, the matter is at length obtained in white and flexible fibres ; in that state it dissolves easily in diluted hydrochloric acid. This substance has the same characters as the animal fibrine. The presence in vegetable milk of a product which is only found ordinarily in the secretions of animals, is a very surprising fact, which we should announce with great circumspection, if one of our most celebrated chemists, Mr. Vauquelin, had not already found the animal fibrine in the milky juice of the *Carica Papaya*. It remains to examine the liquid which, in the milk of the *Palode*

Leche, holds in suspension, in a state of chemical division, the two principles which we have recognized above, the wax and the fibrine. The vegetable milk, poured on a filter, passes with the greatest difficulty; but if alcohol be added, it forms a slight coagulum, and the liquid passes more easily. The liquor, when filtrated, reddens the heliotrope, and deposits no crystals. Evaporated to the consistence of a syrup, and treated with rectified alcohol, it left a little saccharine matter; but the principal mass was not dissolved. The indissoluble portion in the alcohol had a better taste; when dissolved in water, the ammoniac forms a precipitate, as well as the phosphate of soda. We thence presumed that it contained a magnesian salt; in fact, a drop of the solution being placed on a plate of glass near another drop of phosphate of ammonia, when mixed together, characters have been formed, by means of a glass tube. It is known that this *writing-property* belongs to ammoniaco-magnesian phosphate, and the process to Dr. Wollaston. We thought that an acetic acid was combined with magnesia; but the sulphuric acid did not disengage the smell of vinegar; it formed a sulphate, and carbonized the liquor: we are therefore ignorant of the nature of this acid. The matter which remains on the filter has the aspect, when dried, of unrefined wax, and melts, exhaling the odour of meat. The vegetable milk left to itself becomes sour, and acquires a disagreeable smell. During this alteration carbonic acid is disengaged; and an ammoniacal salt is also formed, for the potash disengages volatile alkali. Some drops of acid prevent putrefaction.

“ The constituent parts of the milk of the cow-tree are; 1st. wax; 2d. fibrine; 3d. a little sugar; 4th. a magnesian-salt which is not an *acetate*; and 5th. water. It contains neither caseum, nor caoutchouc; but we found by incineration, silica of lime, phosphate of lime, and magnesia. Such is the summary of the experiments made by M. Rivero and myself on this nourishing juice. The presence of fibrine ex-

plains the nutritive property of the *Palo de Leche*. With respect to the wax, we are ignorant of the effect it produces ordinarily on the animal economy ; in this instance, experience proves that it is not hurtful, since we estimated the quantity at half the weight of the vegetable milk. The cow-tree would be cultivated with advantage were it only in order to extract the wax, which is of an excellent quality ; and would be a new source of wealth to add to the fine agricultural productions of the vallies of Aragua." I ardently wish that those able chemists MM. Boussingault and Rivero, may continue their labors on the milky juices of the equinoxial plants.

Personal Narrative
OF TRAVELS
TO THE
EQUINOCTIAL REGIONS
OF THE
NEW CONTINENT,
DURING THE YEARS 1799—1804,
BY
ALEXANDER DE HUMBOLDT, 10783
AND
AIMÉ BONPLAND;
WITH MAPS, PLANS, &c.
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SKETCH OF A GEOGNOSTIC VIEW

OF

SOUTH AMERICA,

*On the North of the River of the Amazons, and
on the East of the Meridian of the Sierra Ne-
vada de Merida.*

THE object of this memoir is to concentrate the geognostic observations which I was enabled to collect in the course of my journeys among the mountains of New Andalusia, and Venezuela, on the banks of the Oroonoko, and in the *Llanos* of Barcelona, Calabozo, and the Apure; consequently, from the coast of the Caribbean sea, to the valley of the Amazons, between the parallels of 2° and $10\frac{1}{2}^{\circ}$ north latitude. In describing objects as they successively appear to the traveller, every fact remains insulated; he relates what he has seen in following the windings of roads, and a knowledge is thus acquired of the succession of formations in such or such a direction; but we cannot seize their mutual connexion. The order of ideas to which the personal narrative of a journey should be restrained, has the advantage of

making us distinguish more easily what is the result of a direct observation, or that of a combination founded on analogy; but in order to comprehend in one point the geognostic view of a vast part of the globe, and contribute to the progress of geognosy, which is a science of connexion, we must relinquish the sterile accumulation of insulated facts, and study the relations that exist between the inequalities of soil, the direction of the Cordilleras, and the mineralogical nature of the territory.

I passed through an extent of country in different directions, of more than 15,400 square leagues. It has already been the object of a geognostic sketch, traced hastily on the spot, after my return from the Oroonoko, and published in 1801, by M. de Lametherie in the *Journal de Physique* (Vol. xlv, p. 46). At that period, the direction of the Cordillera on the coast of Venezuela, and the existence of the Cordillera of Parime, were not known in Europe. No measure of height had been attempted beyond the province of Quito; no rock of South America had been named; no description existed of the *superposition of rocks*, in any region of the tropics. In such circumstances, an essay tending to prove *the identity of the formations of the two hemispheres*, could not fail to excite the interest of geognosts. The study of the collections that I brought back, and four years

of journeying in the Andes, have enabled me to rectify my first views, and to extend an investigation which, on account of its novelty, had been favorably received. The mineralogical descriptions of every rock have been given in the preceding chapters; it now only remains to collect the scattered materials, and mark the pages where the detail of the observations are found. That the most remarkable geognostic relations may be more easily seized, I shall treat in an aphoristic manner, in different sections, the configuration of the soil, the general division of the land, the direction and inclination of the beds, and the nature of the primitive, intermediary, secondary, and tertiary rocks. The nomenclature I employ in this memoir, is that of which I recently stated the principles in a work on general geognosy*.

SECTION I.

Configuration of the Country.—Inequalities of the Soil.—Chains and groups of Mountains.—Ridges of Partition.—Plains or Llanos.

SOUTH AMERICA is one of those great triangular masses which form the three continental

* See my *Essay on the position of Rocks in the two Hemispheres*, 1823.

parts of the southern hemisphere of the globe. It resembles Africa more in its exterior configuration than New Holland. The southern extremities of the three continents are so placed, that in crossing from the Cape of Good Hope (lat. $33^{\circ} 55'$) to Cape Horn (lat. $55^{\circ} 58'$) and doubling the south point of Van Diemen's land, (lat. $43^{\circ} 38'$), we see those extremities stretching on towards the south-pole in proportion as we advance towards the east. A fourth part of the 571,000 square marine leagues * which South America contains, is covered with mountains distributed in chains, or accumulated in groups. The rest are plains forming long uninterrupted bands covered with forests or gramina, flatter than in Europe, and rising progressively, at 300 leagues distance from the coast, from 30 to 170 toises above the level of the Ocean. (See above, Vol. iv, p. 310; and v, 250.) The most considerable chain of South America extends from south to north, according to the greatest dimension of the continent; it is not central as in Europe, nor far removed from the sea-shore, like Himalaya and Hindoo-Koh; but thrown towards the western extremity of the continent, almost on the coast of the Pacific Ocean. In fixing the eye on the

* Almost the double of Europe, See above, p. 336.

profile which I have given * of the configuration of South America, under the parallel of Chimborazo and Grand Para, across the plains of the Amazon, we saw the land low towards the east, in a talus, like an inclined plane, under an angle of less than 25 seconds, on a length of 600 marine leagues. If, in the ancient state of our planet, the Atlantic Ocean, by some extraordinary cause, ever rose to 1100 feet above its present level (a height one-third less than the interior table-lands of Spain and Bavaria), the waves must have broken in the province of Jaen de Bracamoros, against the rocks that bound the eastern declivity of the Cordilleras of the Andes. The rising of this ridge is so inconsiderable compared to the whole continent, that its breadth in the parallel of the Cape of Saint-Roch is 1400 times greater than the mean height of the Andes.

We distinguish in the mountainous part of South America, a chain and three groups of

* *Map of Columbia, according to the astronomical observations of M. de Humboldt, by A. H. Brué, 1823, to which are joined the profiles of the Cordilleras and the plains. In tracing an outline by the parallel of 5° south latitude, from Jaen de Bracamoros, as far as Cape Saint-Roch, in the greatest breadth of South America from west to east, we find 880 leagues, or a regular slope of $\frac{32}{100}$ feet in the league of 17,130 *pieds de roi*, or of 5 $\frac{3}{10}$ inch in the mile of 951 toises. (See Vol. iv, p. 454.)*

mountains, namely, the Cordillera of the Andes, which the geognost may follow without interruption, from Cape Pilaes, in the western part of the strait of Magellan, to the promontory of Paria, opposite the island of Trinidad; the insulated group of the *Sierra Nevada de Santa Marta*, the group of the *Mountains of the Oroonoko*, or of *la Parime*, and that of the *Mountains of Brazil*. The Sierra de Santa Marta being nearly in the meridian of the Cordilleras of Peru and New-Grenada, navigators fell commonly into the error of supposing the snowy summits which they descry in passing the mouth of the Rio Magdalena, to be the northern extremity of the Andes. I shall soon prove that the colossal group of the Sierra de Santa Marta is almost entirely separate from the mountains of Ocaña and Pamplona, which belong to the eastern Cordillera of New Grenada. The hot plains through which runs the Rio Cesar, and which extend towards the valley of Upar, separate the Sierra Nevada from the Paramo de Cacota, south of Pamplona. The ridge which divides the waters between the gulph of Maracaybo and the Rio Magdalena, is in the plain on the east of the Laguna Zapatoza. If the Sierra de Santa Marta has long been erroneously considered, on account of its eternal snows, and its longitude, to be a continuation of the Cordilleras of the Andes, the connexion on the other

hand, of that very Cordillera with the mountains on the coast of the provinces of Cumana and Caraccas, has not been recognized. The chain of the shore of Venezuela, of which the different ranges form the Montaña de Paria, the isthmus of Araya, the Silla of Caraccas, and the mountains of gneiss-granite north and south of the lake of Valencia, is joined between Portocabello, San Felipe and Tocuyo (by the Torito, the Picacho de Nirgua, the Palomera, and Altar), to the Paramos de las Rosas and Niquitao, which form the north-east extremity of the Sierra de Merida and the eastern Cordillera of the Andes of New Grenada. It is sufficient to have here indicated the connexion, so important in a geognostic point of view; for the denominations of Andes and Cordilleras being altogether in disuse for the chains of mountains which stretch from the eastern gulph of Maracaybo to the promontory of Paria, we shall continue to designate those chains, stretching from west to east, by the names of the *chain of the shore*, or *coast-chain of Venezuela*.

One of those insulated groups of mountains, that is, of those which are not branches of the Cordillera of the Andes and its continuation towards the shore of Venezuela, is on the north, and the other two west of the Andes; the former is the *Sierra Nevada de Santa Marta*; the two others are the *Sierra de la Parime*, between

4° and 8° of north latitude, and the *Mountains of Brazil*, between 15° and 28° south latitude. This singular distribution of great inequalities of soil produces three plains or basins, that constitute altogether a surface of 420,600 square leagues, or four-fifths of all South America, east of the Andes. Between the *chain of the coast of Venezuela* and the *group of Parime*, the *plains of the Apure* and the *Lower Oroonoko* extend; between the *group of the Parime*, and that of the *Mountains of Brazil*, the *plains of the Amazon*, the *Rio Negro*, and the *Madeira*, and between the *groups of Brazil* and the southern extremity of the continent, the *plains of Rio de la Plata*, and of *Patagonia*. As the group of the Parime in Spanish Guyana, and that of Brazil (or of Minas Geraes and Goyaz), do not join the Cordillera of the Andes of New Grenada and Upper Peru, towards the west, the three plains of the Lower Oroonoko, the Amazon, and the Rio de la Plata, communicate together by land-straits of considerable breadth. These straits are also plains stretching from north to south, and crossed by ridges imperceptible to the eye, but forming *divortia aquarum*. These ridges (and this striking phenomenon has not hitherto fixed the attention of geognosts), these ridges, or *lignes de faites*, are placed between the 2° and 3° of north latitude, and the 16° and 18° of south latitude. The

first ridge forms the partition of the waters which throw themselves into the Lower Oroonoko on the north-east, and into the Rio Negro and the Amazon on the south and south-east; the *second ridge* divides the tributary streams of the right bank of the Amazon and the Rio de la Plata. The direction of these *lignes de fautes* is such, that if they were marked by the chains of mountains they would unite the group of the Parime to the Andes of Timana (*Per. Nar.* Vol. v, p. 326), and the mountains of Brazil to the promontory of the Andes of Santa Cruz de la Sierra, Cochabamba, and Potosi. We make a supposition so vague, only that the outline of this vast portion of the globe may be more easily perceived. These risings in the plain, in the intersection of two plains slightly inclined, those two ridges, of which the existence is only manifested, as in Volhinia * by the course of the waters, are parallel to the chain of the coast of Venezuela; they present, it may be said, *two systems of counter-slopes little developed*, in the direction from west to east, between the Guaviare and the Caqueta, and between the Mamori and the Pilcomayo. It is also wor-

* On the partition of the waters between the Dniéper (or the Black Sea), and the Niemen (or the Baltic), *See the hydrographic map of Poland, by MM. Perthes and Komarcewsky, 1809.*

thy of remark, that in the southern hemisphere, the Cordillera of the Andes sends an immense counterpoise towards the east, the promontory of the Sierra Nevada de Cochabamba, whence begins the ridge stretching between the tributary streams of the Madeira and Paraguay towards the lofty group of the mountains of Brazil or Minas Geraes. Three transversal chains (the mountains of the shore of Venezuela, of the Oroonoko, or Parime, and the mountains of Brazil) tend, it may be said, to join the longitudinal chain (the Andes), either by an intermediary group (between the lake of Valencia and Tocuyo) or by ridges formed by the intersection of counter-slopes in the plains. The two extremities of the three Llanos which communicate by land-straits, the Llanos of the Lower Oroonoko, the Amazon, and the Rio de la Plata or of Buenos Ayres, are steppes, covered with gramina, while the intermediary Llanos, that of the Amazon, is a thick forest. With respect to the two land-straits, forming bands directed from north to south (from the Apure to Caqueta across the Provincia de los Llanos, and the sources of the Mamori to Rio Pilcomayo, across the province of Mocos and Chiquitos) they display bare and grassy steppes like the plains of Caraccas and Buenos Ayres.

In the immense space of land east of the Andes, which comprehends more than 480,000

square marine leagues, of which 92,000 are a mountainous country, no groupe rises to the region of perpetual snows ; none even attains the height of 1,400 toises. This lowering of the mountains in the eastern region of the New Continent, extends as far as 60° of north latitude ; while in the western part, on the prolongation of the Cordilleras of the Andes, the highest summits rise in Mexico (lat. $18^{\circ} 59'$), to 2,770 toises, and in the Rocky Mountains (lat. 37° to 40°) to 1,900 toises. The insulated groupe of the Alleghanies, which corresponds by its eastern position and direction with the groupe of Brazil, does not surpass 1,040 toises*. The lofty summits therefore, exceeding the height of Mont Blanc, belong only to the longitudinal chain that bounds the basin of the Pacific Ocean, from the 55° south to the 68° north, that is to say, the Cordillera of the Andes. The only insulated groupe that can be compared with the snowy summits of the equinoxial Andes, and which attains the height of nearly 3,000 toises, is the Sierra de Santa Marta ; it is not placed on the east of the Cordilleras, but between the prolongation of two of their branches, those of Merida and Veragua. The Cordilleras,

* The culminant point of the Alleghanies is Mount Washington, in New Hampshire, lat. $44\frac{1}{4}^{\circ}$. According to Captain Partridge it is 6634 English feet.

where they bound the Caribbean sea, in that part which we denote by the name of *Chain of the shore of Venezuela*, do not attain the extraordinary height (2,500 toises) which they reach in their prolongation towards Chita and Merida. In considering separately the groupes of the east, those of the shore of Venezuela, Parime, and Brazil, we see them diminish from north to south. The highest summits of each groupe are the Silla de Caraccas (1350 toises), the peak Duida (1300 toises), the Itacolumi and the Itambe* (900 toises). But, as I have already observed in another place†, it would be an error to judge the height of a chain of mountains solely from that of the most lofty summits. The peak of the Himalaya‡, most exactly measured, is 676 toises higher than the Chimborazo; the Chimborazo 900 toises higher than Mont Blanc; and Mont Blanc 653 toises higher than the peak Nethou§. These differ-

* According to the measure of MM. Spix and Martins, the Itambe de Villa de Principe is 5590 feet high. (*Martin's Physiognomy of Pflanzenreichs in Brasilien*, 1824, p. 23.)

† See my first memoir on the mountains of India, in the *Annales de chimie et de physique*, 1816, Vol. iii, p. 313.

‡ The Peak Iewahir, lat. $30^{\circ} 22' 19''$; long. $77^{\circ} 35' 7''$ east of Paris. Height 4026 toises, according to MM. Hodgson and Herbert.

§ This peak, called also peak of Anethou or Malahita, or eastern peak of Maladetta, is the highest summit of the Pyrenees. It rises 1787 toises, and consequently exceeds

ences do not furnish the relations of the mean height of the Himalaya, the Andes, the Alps, and the Pyrenees, that is, the height of the *back of the mountains*, on which arise the peaks, needles, pyramids, or rounded domes. It is that part of the back where the *passages* are made, that furnishes a precise measure of the *minimum* of the height attained by the great chains. In comparing the whole of my measures with those of Moorcroft, Webb and Hodgson, Saussure and Ramond, I estimate the *mean height* of the top of the Himalaya, between the meridians of 75° and 77° , at 2450 toises; the Andes * (at Peru, Quito, and New

Mont Perdu 40 toises. (Vidal and Reboul, in the *Annales de chimie*, tom. v, p. 234, and in the *Journal de physique*, 1822, Dec. p. 418, Charpentier, *Essai sur la constit. géognost. des Pyrénées*, p. 823, 539.)

* In the passage of Quindiu, between the valley of Magdalena and that of the Rio Cauca, I found the culminant point (la Garita del Parama), at 1798 toises of absolute height; it is however, regarded as one the least elevated. The *passages of the Andes* of Guanacas, Guamani, and Micuipampa are respectively 2300, 1713, and 1817 toises above the surface of the ocean. Even in 33° south latitude, the road which crosses the Andes between Mendoza and Valparaiso is 1987 toises high. See my *Astron. Obs.* Vol. i, p. 312, 314, and 316, *Caldas, Semanario de Santa Fe de Bogota*, tom. i, p. 8 and 38. I do not mention the Col de l'Assuay, where I passed, near la Ladera de Cadlud, on a ridge 2428 toises high, because it is a passage on a transversal ridge that joins two parallel chains.

Grenada), at 1850 toises ; the top of the Alps and Pyrenees at 1150 toises. The difference of the *mean height* of the Cordilleras (between the parallels of 5° north and 2° south) and the Alps of Switzerland, is consequently 200 toises less than the difference of their loftiest summits ; and in comparing the *passages* of the Alps, we see that the mean height of their tops is nearly the same, although the peak Nethou is 600 toises lower than Mont Blanc and Mont Rose. Between Himalaya* and the Andes, on the

* The *passages* of the Himalaya that lead to Chinese Tartary in Hindostan (Nitee-Ghaut, Bamsaru, Chatoulghati, &c.) are from 2400 to 2700 toises of absolute height. With respect to the most elevated top of the Himalaya, I have chosen it among the peaks placed between the meridians of the lake Manasarowar and Balaspore, they only having been measured with great precision by MM. Webb, Hodgson, and Herbert. (*Asiat. Research.* Vol. xiv, p. 187, 373 ; *Edinb. Phil. Journ.*, 1823, in-18, p. 312). We know no measure so precise, says Captain Hodgson, south-east of lat. 30° 22', and long. 77° 37'. There may be still loftier summits in the meridian of Gorukpur and that of Rungpur ; and it has, in fact, been concluded, according to angles taken at very great distances, that the peak of Chamalari, near which Turner passed in going to Tissu-Lumbu, and the peak Dhawalagiri, south of Mustang, near the source of the Gunduck, was 28,077 English feet, (4390 toises) high. (*Journ. of the Roy. Instit.*, 1821, Vol. ii, p. 242.) The measure of Dhawalagiri by Webb, so ably discussed by Mr. Colebroke, was confirmed by Mr. Blake ; but, in the table furnished in this memoir, I thought it would be more prudent for the present,

contrary, (considering those chains in the limits which I have just indicated,) the difference between the mean height of the ridges and that of the loftiest summits preserves nearly the same relations. In applying an analogous reasoning to those groupes of mountains which we have made known, at the east of the Andes, we find the mean height of the chain of the shore of Venezuela to be 750 toises; of the Sierra Parime, 500 toises; of the Brazilian groupe, 400 toises; whence it follows that the mountains of the eastern region of South America, are, between the tropics, to the mean elevation of the Andes, in the relation of 1 to 3. The following is the result of some numerical statements, of which the comparison affords more precise ideas on the structure * of mountains in general.

to give the preference to the peak Iewahir, measured by Mr. Herbert. Those measures will be discussed in another place.

* The *necks* or *passages* indicate the *minimum* of the height to which the ridge of the mountains lowers in such or such a country. Now, in casting a look on the principal passages of the Alps of Switzerland, (col de Seigne, 1263 t.; col Terret, 1191 t.; Mont-Cenis, 1060 t.; Petit Saint-Bernard, 1125 t.; Grand Saint-Bernard, 1246 t.; Simplon, 1029 t.; Saint-Gothard, 1065 t.; la Fourche, 1250 t.); and on the neck des *Pyrénées* (Picade, 1243 t.; Benasque, 1231 t.; la Glère, 1196 t.; Pinède, 1291 t.; Gavarnic, 1197 t.; Cava-rère, 1151 t.; Tourmalet, 1126 t.); it would be difficult to affirm that the top of the Pyrenees is lower than the mean height of the Swiss Alps. (*Ramond, Voyage au Mont-Perdu,*

| NAMES OF THE CHAINS OF MOUNTAINS. | The highest summits. | Mean height of the ridge. | Relation of the mean height of the ridges to that of the highest summits. |
|--|----------------------|---------------------------|---|
| Himalaya (between nor. lat. 30° 18' and 31° 53', and long. 75° 23' and 77° 38')..... | 4026 t. | 2450 t. | 1 : 1·6 |
| Cordilleras of the Andes (between lat. 5° nor. and 2° south.....) | 3350 t. | 1850 t. | 1 : 1·8 |
| Alps of Switzerland..... | 2450 t. | 1150 t. | 1 : 2·1 |
| Pyrenees..... | 1787 t. | 1150 t. | 1 : 1·5 |
| Chain of the shore of Venezuela. | 1350 t. | 750 t. | 1 : 1·8 |
| Groupe of the mountains of Parime..... | 1300 t. | 500 t. | 1 : 2·6 |
| Groupe of the mountains of Brazil..... | 900 t. | 400 t. | 1 : 2·3 |

If we distinguish among the mountains those which rise in detached masses, and form small insulated *systems* (the groupes of the Canaries, the Azores, the Sandwich Islands, the Monts Dores, the Euganees), and those that make a part of a continued chain (Himalaya, Alps,

p. 23.) What characterizes the latter chain, is the *relative* height of the summits (that is, the elevation of those summits compared with the top), which is much less in the Pyrenees, in the Andes, and in Himalaya; for even in adopting the measure of Dhawalagiri (4390 t.), we still find for the Himalaya, only the relation of 1 : 1·7.

Andes,) we may observe that, notwithstanding the immense height* of the summits of some insulated systems, the *culminant points of the whole globe* belong to continued chains, to the Cordilleras of central Asia, and South America.

In that part of the Andes with which I am best acquainted, between 8° of south latitude, and 21° of north latitude, all the colossal summits are of trachyte. It may almost be admitted as a general rule, that whenever the mass of mountains rises in that region of the tropics much above the limit of perpetual snows (2300—2470 toises), the rocks vulgarly called primitive (for instance the gneis-granite or micaslate) disappear, and the summits are of trachyte or trapean-porphry. I know only a few rare exceptions to this law in the Cordilleras of Quito, where the Nevados of Conderasto and Cuvillan, placed opposite the trachytic Chimborozo, are composed of micaslate, and contain veins of sulphurated silver. In the same manner, in the groupes of detached mountains that rise abruptly from the plains, the loftiest summits

* Among the *insulated systems*, or *sporadic mountains*, the Mowna Roa is generally regarded as the most elevated summit of the Sandwich Islands ; it is computed at 2500 toises, and is yet at some seasons entirely stript of its snows. (*Personal Nar.* Vol. i, p. 105). An exact measure of this summit, situated in very frequented latitudes, has during 25 years, been claimed in vain by naturalists and geognosts !

(Mowna Roa, Peak of Teneriffe, Etna, Peak of the Azores), furnish only modern volcanic rocks. It would however, be an error to extend that law to every other continent, and to admit in general that, in every zone, the greatest elevations have produced *trachytic domes*; gneiss-granite and mica-slate constitute, in the almost insulated groupe of the Sierra Nevada of Grenada, the Peak of Malhacen*, as they also constitute in the continued chain of the Alps, the Pyrenees, and probably the Himalaya†, the summits of the ridge. Perhaps these phenomena, discordant in appearance, are effects of the same cause; perhaps granite, gneiss, and all the pretended *primitive Neptunian mountains*, are owing to volcanic forces, as well as the trachytes; but to forces of which the action resembles less the still burning volcanoes of our days, ejecting lava, which at the moment of its

* This peak, according to the survey of M. Clemente Roxas, is 1826 toises above the level of the sea, consequently 39 toises higher than the loftiest top of the Pyrenees (the granitic peak of Nethou), and 83 toises lower than the trachytic peak of Teneriffe. The Sierra Nevada of Grenada forms a system of mountains of mica-slate, passing to gneiss and clay-slate, and which contains shelves of euphotide and green-stone. See the excellent geognostic memoir of Don Jose Rodrigues in the *Ann. de Chimie*, Tom: xx, p. 98.

† If we may judge from the specimens of rocks collected in the *necks* and *passages* of the Himalaya, or rolled down by the torrents.

eruption enters immediately into contact with the atmospheric air; but it is not here my purpose to discuss this great theoretic question.

After having examined the general structure of South America according to considerations of *comparative geognosy*, I shall now state separately the *different systems of mountains and plains*, of which the mutual connection has so powerful an influence on the state of industry and commerce of the nations of the New Continent. I shall give only a general view of the systems placed beyond the limits of the region which forms the special object of this memoir. Geology being essentially founded on the study of the relations of juxta-position and place, I could not treat of the chains of the shore and of Parime separately, without touching on the other *systems* placed south and west of Venezuela.

A. *Systems of Mountains.*

a. CORDILLERAS OF THE ANDES. This is the most continued, the longest, the most constant in its direction from south to north, and north-north-west, of any chain of the globe. It approaches the north and south poles at unequal distances of from 22° to 33° . Its development is from 2800 to 3000 leagues, (20 to a degree,) a length equal to the distance from Cape Finisterre in Galicia to the north-east Cape (Tschuktschoi-Noss) of Asia. Somewhat less than

the half of this chain belongs to South America, and runs along its western coast. On the north of the isthmus of Cupica and of Panama, after an immense lowering, it assumes the appearance of a nearly central ridge, forming a rocky dyke that joins the great continent of North America to that of the south. The low lands on the east of the Andes of Guatemala and New Spain, appear to have been overwhelmed by the floods, and now form the bottom of the Caribbean Sea. As the continent beyond the parallel of Florida again widens towards the east, the Cordilleras of Durango and New Mexico, as well as the Rocky Mountains which are a continuation of those Cordilleras, appear to be thrown anew towards the west, that is, towards the coast of the Pacific Ocean; but they still remain eight or ten times more remote from it than in the southern hemisphere. We may consider as the two extremities of the Andes, the rock or granitic isle of Diego Ramirez, south of Cape Horn, and the mountains that reach the mouth* of the Mac-

* I have fixed the longitude of the northern extremity of the chain of the Andes in the *Rocky Mountains*, according to the corrections made recently by Captain Franklin, in Mr. Mackenzie's map. The errors in latitudes 67° and 69°, appear from 4° to 6° longitude; but in the parallel of the Slave Lake they are almost nothing. (Mouth of the Mackenzie river, according to Franklin, 128°; according to Mackenzie,

kenzie river, (lat. 69° , long. $130\frac{1}{2}^{\circ}$), more than twelve degrees west of the green-stone mountains *, known by the denomination of the *Copper Mountains*, and visited recently by Captain Franklin. The colossal peak of Saint Elia, and that of Mount Fairweather, of New Norfolk, do not belong, properly speaking, to the northern prolongation of the Cordilleras of the Andes, but to a parallel chain (the maritime Alps of the north-west coast), stretching towards the peninsula of California, and connected by transversal ridges with a mountainous land, between the 45° and 53° of latitude, with the Andes of New Mexico (*Rocky Mountains*). In South America (and my *geognostic table* is particularly restricted to that part of the New Continent), the mean breadth of the Cordillera of the Andes is from 18 to 22

135° : mouth of the Copper-mine river, according to Franklin, $115^{\circ} 37'$; according to Mackenzie and Hearne, 111° : mouth of the Slave River, in the lake of that name, according to Franklin, $112^{\circ} 45'$; according to Mackenzie, 113° west of Greenwich). From these statements it results, 1st. that the Rocky Mountains are in the parallel from 60° to 65° , at 124° to 125° long. west of the meridian of Paris; 2d. that the northern extremity of the chain, west of the mouth of Mackenzie river, is $130^{\circ} 20'$ of long.; and, 3d. that the groupe of the Copper-Mountains is 118° and 119° long., and 67° and 68° latitude. *Franklin's Journal to the Polar Sea*, p. 638.

* See an excellent geognostic memoir by Mr. Richardson, in Franklin's Journ. page 528.

leagues *. It is only in the *knots of the mountains*, that is, where the Cordillera is swelled by *counter-forts*, or divided into several chains nearly parallel, and that are rejoined at intervals, for instance, on the south of the lake of Titicaca, that it is more than 100 to 120 leagues broad, in a direction perpendicular to its axis. The *Andes of South America* bound the plains of the Orinoko, the Amazon, and the Rio de la Plata towards the west, like a rocky wall (*Crete de filon*) which had been raised across a crevice 1300 leagues long, and stretching from south to north. This heaved up part (if it be permitted to use an expression founded on a *geogonic hypothesis*), comprises a surface of 58,900 square leagues, between the parallel of Cape Pillar, and the northern Choco. In order to form an idea of the variety of rocks which this space may furnish for the observation of the traveller, we must recollect that the Pyrenees, according to the observations of M. Charpentier †, occupy only 768 square marine leagues.

* The breadth of this immense chain is a phenomenon well worthy of attention. The Swiss Alps extend in the Grisons and in the Tyrol, to a breadth of 36 and 40 leagues, both in the meridians of the lake of Como, and the canton Apenzell, and in the meridian of Bassano and Tegernsee.

† Nearly 1200 square leagues of France. See *Essai sur les Pyrénées*, p. 6.

The name of Andes in the Quichua language (language of the Inca), which wants the consonants *d*, *f*, and *g*, *Antis*, or *Ante*, appears to me to be derived from the Peruvian word *anta*, signifying copper, and metal in general. They also say *anta chacra*, mine of copper; *antacuri*, copper mixed with gold; *puca anta*, copper, or red metal. As the group of the Altai mountains * has taken the denomination in the Turkish dialects of the word *altor* or *altyn*, in the same manner the Cordilleras must have been termed *Copper-country* or *Anti-suyu*, on account of the abundance of metal which the Peruvians employed for their tools. The Inca Garcilasso, son of a Peruvian princess, who wrote with an affecting simplicity the history of his native country in the first years of the conquest †, gives no etymology of the name of the Andes. He only opposes *Anti-suyu*, or the region of summits covered with eternal snows (*ritiseca*), to the plains or *Yuncas*, that is, to the lower region of Peru. I thought that the etymology of the longest chain of the globe would have some interest for the mineralogic geographer.

* *Klaproth, Asia polyglotta*, p. 211. It appears to me less probable that the tribe of the Antis gave its name to the mountains of Peru.

† Basil Hall, *Journal in Chili and Peru*, 1824, Vol. i, p. 3.

The structure of the Cordillera of the Andes, that is, its disposition in several chains nearly parallel, which are rejoined by *knots of mountains*, is very remarkable. Our maps indicate this structure in the most imperfect manner; and what La Condamine and Bouguer had guessed, during their long stay on the tableland of Quito only, has been generalized and ill-interpreted by those who have described the whole chain according to the type of the equatorial Andes. The following is what I could collect that was most positive by my own researches, and an active correspondence of twenty years with the inhabitants of Spanish America. The group of islands very near each other, vulgarly called Land of Fire, in which the chain of the Andes begins, is a plain from the Cape of Saint Esprit as far as the canal of Saint Sebastian. The country on the west of this canal, between Cape Saint Valentin and Cape Pilares, is bristled with granitic mountains that are covered (from Morro de San Agueda to Cabo Redondo) with calcareous shells. Navigators have greatly exaggerated the height of the mountains of the Land of Fire, among which there appears to be a volcano still burning. M. de Churruca found the western peak of Cape Pilares (lat. $52^{\circ} 45'$ south) only 218 toises *; even Cape Horn is probably not more

* *Relacion del viage al Estrecho de Magellanes. Appendice. 1793, p. 76.*

than 500 toises * high. The plain extends on the northern bank of the strait of Magellan, from the Cape of Virgins, to Cabo Negro ; at that Cape the Cordilleras rise abruptly, and fill the whole space as far as Cape Victoria (lat. $52^{\circ} 22'$). The region between Cape Horn and the southern extremity of the continent somewhat resembles the origin of the Pyrenees between Cape Creux (near the gulph of Rosas), and the Col de Pertus. The height of the Patagonian chain is not known ; it appears, however, that no summit south of the parallel of 48° , attains the elevation of Canigou (1430 toises), which is placed near the eastern extremity of the Pyrenees. In the southern country, where the summers are so cold and short, the limit of the eternal snows must lower at least as much as in the northern hemisphere, in Norway, in 63° and 64° latitude, consequently below 800 toises †.

* It is very distinctly seen at 60 miles distance, which, without counting the terrestrial refractions, would give it a height of 498 toises.

† I have founded my judgment on the limit of the snows between 48° and 51° in the Patagonian lands, and on the analogy of climate of the Malouine islands (lat. $51^{\circ} 25'$), the only point equally south which we know with precision. The mean temperature of the whole year in the Malouines, ($8\cdot3$ cent.) corresponds, it is true, with that of Edinburgh (lat. $55^{\circ} 57'$) in the northern hemisphere ; but such is the difference of the division of heat, between the different sea-

The great breadth, therefore, of the band of snow that envelopes these Patagonian summits, does not justify the idea formed of their height by travellers, in 40° of south latitude. As we advance towards the Island of Chiloe, the Cordilleras draw near the coast; and the Archipelago of Chonos or Huaytecas appears like the vestiges of an immense group of mountains overwhelmed by the floods. Arms of narrow seas (*esteros*) fill the lower vallies of the Andes, and remind us of the *fiords* of Norway and Greenland. We there find, ranged from south to north*, the *Nevados* de Maca (lat. $45^{\circ} 19'$), of Cuptana (lat. $44^{\circ} 58'$), of Yanteles (lat. $43^{\circ} 52'$) of Corcovado, Chayapirca (lat. $42^{\circ} 52'$) and of Llebcan (lat. $41^{\circ} 49'$). The peak of Cuptana rises like the peak of Teneriffe, from the bosom of the sea; but being scarcely visible at 36 or 40 leagues distance, it cannot be more than

sons, in the two hemispheres, on the same line, that the mean temperature of the summers at Edinburgh is $14^{\circ} 6'$, and at the Malouine islands scarcely $11^{\circ} 4'$. Now, the isotherm line (equal summer) from 11° to 12° passes in our hemisphere, on the eastern coast of Westrobornie, in 64° of latitude, and it is known that these cold summers correspond with a height of perpetual snows, of 750 to 800 toises. See my memoir on the Isotherm lines, p. 112.

* Manuscripts and maps of Don Jose de Moraleda. (See also Sir Charles Giesecke in Scoresby's voy. to West-Greenland, p. 467.)

1500 toises high. Corcovado, placed on the coast of the continent, opposite the southern extremity of the island of Chiloe, appears to be more than 1950 toises high ; it is perhaps, the loftiest summit of the whole globe, *south of the parallel of 42° south latitude*. On the north of San Carlos de Chiloe, in the whole length of Chili to the desart of Atacama, the low western regions not having been overwhelmed by the floods, the Andes there appear farther from the coast. The Abbé Molina *, always positive in what is doubtful, affirms that the Cordilleras of Chili, form three parallel chains, of which the intermediary is the most elevated ; but to prove that this division is far from general, it suffices to recollect the barometric survey made by MM. Bauza and Espinosa, in 1794, between Mendoza and Santiago de Chili. The road which leads from one of those towns to the other, rises by degrees from 700 to 1987 toises ; and after passing the col des Andes (*La Cumbre*, between the houses of refuge called *Las Calaveras* and *Las Cuevas*), it descends continually as far as the temperate valley of Santiago de Chili, of which the bottom is only 409 toises above the level of the Ocean. The same survey has made known to us the *minimum* of

* *Saggio*, p. 4, 38, 48. Compared with the *manuscripts* of M. Née, botanist of the Malaspina expedition.

height at Chili of the lower limit of snow, in the 33° of south latitude. The limit does not lower in summer to 2000 toises*. I think we may conclude, according to the analogy of the *snowy mountains* of Mexico and southern Europe, and considering the difference of the *estivale* temperatures of the two hemispheres, that the real *Nevadas* at Chili, in the parallel of Valdivia (lat. 40°), cannot be below 1300 toises; in that of Valparaiso (lat. 33°) not lower than 2000 toises, and in that of Copiapo (lat. 27°) not below 2200 toises of absolute height. They are the limit numbers, the *minimum* of elevation, which the ridge of the Andes of Chili must attain by different degrees of latitude, in order that their summits, more or less grouped, pass not the line of perpetual snows. The numeric results which I have just marked, and which are founded on the laws of the distribution of heat, have still the same importance as they had at the period already distant of my travels in America; *for there does not exist in the immense extent of the Andes, from 8° of south latitude to the strait of Magellan, one Nevada of which the height above the level of the Ocean has been determined, either by*

* On the *southern declivity* of the Himalaya, the snows begin 3° nearer the equator, at 1970 toises.

a simple geometric measure, or by the combined means of barometric, and geometric measures *.

The Andes, between 33° and 18° of south latitude, between the parallels of Valparaiso and Arica, present towards the east three remarkable counter-forts, the Sierra de Cordova, de Salta, and the Nevados de Cochabamba. Travellers partly cross, and partly go along the side of the *Sierra de Cordova* (between 33° and 31° of latitude), in their way from Buenos Ayres to Mendoza; it may be said to be the most southern promontory which advances in the Pampas, towards the meridian of 65° ; it gives birth to the great river known by the name of Desaguadero of Mendoza, and extends from San Juan de la Frontera and San Juan de la Punta to the town of Cordova. The second counter-fort, the Sierra de Salta and the Jujui, of which the greatest breadth is 25° of latitude, widens progressively from the valley of Catamarca and San Miguel del Tucuman, towards

* The simultaneous employment of both these means is necessary wherever a base cannot be measured at the level of the sea, or a plan taken from the table-land on which the base has been measured as far as the coast. The want of portable barometers, and ignorance of the use of instruments of reflexion, and artificial horizons, retard the progress of physical geography in the high chains of mountains; and has been especially prejudicial to the hypsometry of the Andes, and the Rocky Mountains.

the Rio Vermejo (longitude 64°). Finally, the third, and most majestic counter-fort, the *Sierra Nevada de Cochabamba and Santa Cruz* (from 22° to $17\frac{1}{2}^{\circ}$ of latitude), is linked with the knot of the mountains of Porco. It forms the point of partition (*divortia aquarum*), between the basin of the Amazon and that of the Rio de la Plata. The Cachimayo and the Pilcomayo, which rise between Potosi, Talavera de la Puna, and La Plata or Chuquisaca, run towards the south-east, while the Parapiti and the Guapey (Gua-paiz, or Rio de Mizque), pour their waters into the Mamori, towards the north-east. The *ridge of partition* being placed near Chayanta, south of Mizque, Tomina, and Pomabamba, nearly on the southern declivity of the Sierra de Cochabamba in the 19° and 20° of latitude, the Rio Guapey is forced to flow around the whole group, in order to reach the plains of the Amazon, like the Poprad in Europe, a tributary stream of the Vistula, to attain the southern part of the Carpathes of Tatra in the plains of Poland. I have already observed above, that where the mountains cease (west * of the meridian of

* I suppose, with Captain Basil Hall, that the port of Valparaiso is $71^{\circ} 31'$ west of Greenwich, and I place Cordova $8^{\circ} 40'$, and Santa Cruz de la Sierra $7^{\circ} 4'$ east of Valparaiso. The longitudes indicated in the text, and constantly referring to the meridian of the Observatory of Paris, are

66½°), the ridge of partition of Cochabamba goes up towards the north-east, to 16° of latitude, forming by the intersection of two planes slightly inclined, one *wall* only amidst the savannahs, and separating the waters of the Guaporè, a tributary stream of the Madeira, from those of the Aguapehy and Jauru, tributary streams of the Rio Paraguay. This vast country between Santa Cruz de la Sierra, Villabella, and Matogrosso, is one of the most unknown of South America. The two counter-forts of Cordova and Salta present only a mountainous territory * of small elevation, and which is linked to the foot of the Andes of Chili. The counter-fort of Cochabamba, on the contrary, attains the limit of perpetual snows (2300 toises), and forms in some sort a lateral branch of the Cordilleras, diverging even from their tops between La Paz and Oruro. The mountains composing this branch (Cordillera de Chiriguaes, de los Sauces and Yuracarées), stretch regularly from west to east; their eastern de-

not taken from published maps; they are founded on combinations of astronomical geography of which the elements will be found in the Analysis of my Atlas of South America.

* I can scarcely believe that even the town of Jujuy is 650 toises above the level of the Ocean, as Mr. Redhead pretends in his book *Sobre la dilatacion del aire atmosferico*. (Buenos Ayres, 1819,) p. 10.

clivity * is very rapid, and their loftiest summits are placed not at the centre, but in the northern part of the group.

The principal Cordillera of Chili and Upper Peru, after having thrown towards the east the three counter-forts of Cordova, Salta, and Cochabamba or Santa Cruz, is, for the first time, ramified very distinctly into two branches, in the *knot of Porco, and Potosi*, between 19° and 20° of latitude. These two branches comprehend the table-land extending from Carangas to Lampa (lat. 19 $\frac{3}{4}$ °—15°) and which contains the small alpine lake of Paria, the Desaguadero, and the great Laguna of Titicaca or Chucuito, of which the western part bears the name of Vinamarca. To give a just idea of the colossal dimensions of the Andes, I shall here observe that the surface of the lake of Titicaca only (448 square marine leagues) exceeds twenty times that of the lake of Geneva, and twice the mean extent of a department of France. It is

* I owe a more perfect knowledge of the Sierra de Cochabamba, to the manuscripts of my countryman the celebrated botanist, Taddeus Haenke, which a monk of the congregation of the Escorial, father Cisneros, kindly communicated to me at Lima. Mr. Haenke, after having followed the expedition of Alexander Malaspina, settled at Cochabamba, in 1798, where he received great proofs of the friendship of the intendant, Don Francisco de Viedma. A part of the immense herbal of this botanist is now at Prague.

on the banks of this lake, near Tiahuanacu, and in the high plains of Collao, that ruins are found which attest a state of civilization * anterior to that which the Peruvians attribute to the reign of the Inca Manco Capac. The eastern Cordillera, that of Le Paz, Palca, Ancuma, and Pelechuco, join, north-west of Apolobamba, the western Cordillera, which is the most extensive of the whole chain of the Andes, between the parallels 14° and 15° . The *imperial town* of Cuzco is placed near the eastern extremity of this knot, which comprehends, in an area of 3000 square leagues, the mountains of Vilcanota, Carabaya, Abancai, Huando, Parinacochas, and Andahuaylas. Although here, as in general, in every considerable widening of the Cordillera, the grouped summits do not follow the principal axis in constant and parallel directions, a phenomenon was however observed in the general disposition of the chain of the Andes, from lat. 18° well worthy the attention of geologists. The whole mass of the Cordilleras of Chili and Upper Peru, from the strait of Magellan to the parallel of the port of Arica ($18^{\circ} 28' 35''$), is directed from south to north, in the manner of a meridian at most 5° N. E.; but from the parallel of Arica, the coast and the two Cordilleras east and west of the

* Garcilasso, *Comentarios Reales*, T. i. p. 21.

Alpine lake of Titicaca change their direction abruptly, and incline towards the north-west. The Cordilleras of Ancuma and Moquehua, and the longitudinal valley, or rather the basin of Titicaca, which they inclose, are directed N. 42° W. Further on, the two branches again unite in the *knot of the mountains of Cuzco*, and thence their direction is N. 80° W. This knot, of which the table-land inclines to the north-east, presents a real curve, nearly directed from east to west, so that the part of the Andes north of Castrovireyna is thrown back more than 242,000 toises towards the west. So singular a geological phenomenon reminds us of the *variation d'allure* of the veins, and especially of the two parts of the chain of the Pyrenees, parallel to each other, and linked by an almost rectangular elbow, 16,000 toises long, near the source of the Garonne *; but in the Andes, the axes of the chain, south and north of the curve, do not preserve a parallelism. On the north of Castrovireyna and Andahuaylas (lat. 14°), the direction is N. 22° W., while south of 15° , it is N. 42° W. The inflexions of the coast follow these changes; the shore separated from the Cordillera by a plain 15 leagues broad, stretches like the Cordillera at Arica, between $27\frac{1}{2}^{\circ}$ and

* Between the mountain of Tentenade and the Port d'Espot (*Charpentier*, p. 10).

$18\frac{1}{2}^{\circ}$ of latitude, N. 5° E.; from Arica to Pisco, between $18\frac{1}{2}^{\circ}$ and 14° latitude, at first N. 42° W., afterwards N. 65° W.; and from Pisco to Truxillo, between 14° and 8° of latitude, N. 27° W. The parallelism between the coast and the Cordillera of the Andes is a phenomenon so much more worthy of attention, that it is repeated in several parts of the globe where the mountains do not in the same manner form the shore. To this consideration is joined another which relates to the general outline of continents. I fix on the geographical position of the point ($14^{\circ} 28'$ south latitude) where, on the parallel of Arica, the inflexion of the coast, and the *variation d'allure* of the Andes of Upper Peru, begin. The resemblance of configuration which the triangular masses of South America and Africa display, is manifest in many details of their outline. The gulphs of Arica, and of Ilo correspond to the gulph of Guinea. The inflexion of the western coast of Africa begins 3° north of the equator; and if we consider the Archipelago of India geologically, as the remains of a destroyed continent, as the link between eastern Asia and New Holland, we see the gulph of Guinea, that which forms Java, Bali, and Sumbava, with the Land de Witt, and the Peruvian gulph of Arica, following from north-west to south-south-east (lat. 3° N. lat. 10° S., lat. $14\frac{1}{4}^{\circ}$ S.), almost in the same di-

rection as the extremities of the three continents of Africa, Australasia, and America *.

After the great *knot of mountains* of *Cuzco* and *Parinacochas*, in 14° south latitude, the Andes present a *second bifurcation*, on the east and west of the Rio Jauja, which throws itself into the Mantaro, a tributary stream of the Apurimac †. The eastern chain stretches on the east of Huanta, the convent of Ocopa and Tarma, the western chain, on the west of Castrovireyna, Huancavelica, Huarocheri, and Yauli. The basin, or rather the lofty table-land which is inclosed by these chains, is nearly half the length of the basin of Chucuito or Titicaca. Two mountains covered with eternal snow, seen from the town of Lima, and which the inhabitants name *Toldo de la Nieve*, belong to the western chain, that of Huarocheri.

On the north-west of the vallies of Salcambamba, in the parallel of the ports of Huaura and Guarmey, between 11° and 10° latitude, the two chains unite in the knot of the Huanuco and the Pasco, celebrated for the mines of Yauricocha or Santa Rosa. There rise two peaks of colossal height, the Nevados of Sasa-

* See above, p. 393.

† See le *Plan del curso de los Rios Huallaga y Ucayali* por don Padre Sobreviola, 1791. The Apurimac forms, conjointly with the Beni, the Rio Paro, which takes the name of Ucayali, after its confluence with the Rio Pachitea.

guanica and of la Viuda. The table-land of this knot of mountains appears in the Pampas de Bombon *, to be more than 1800 toises above the level of the Ocean. From this point, on the north of the parallel of Huanuco, (lat. 11°) the Andes are divided into three chains, of which the first, and most eastern, rises between Pozuzu and Muna, between the Rio Huallaga, and the Rio Pachitea, a tributary of the Ucayali; the second, or central, between the Huallaga, and the Upper Maragnon; the third, or western, between the Upper Maragnon and the coast of Truxillo and Payta †. The eastern chain is a small lateral branch which lowers into a range of hills; directed first towards the N.N.E., bordering the Pampas del Sacramento, afterwards towards the W.N.W., where it is broken by the Rio Huallaga, in the Pongo, above the confluence of Chipurana, the eastern chain loses itself in $6\frac{1}{4}^{\circ}$ of latitude, on the north-west of Lamas. A transversal ridge seems to join it with the central chain, south of Paramo ‡, de Piscoguanuna (or Piscuaguna), west of Chachapoyas. The intermediary or central chain stretches from the knot of Pasco and Huanuco, towards the N.N.W. between Xican

* Political Essay, Vol. iii, p. 341.

† See above, Vol. v, p. 39.

‡ See above, Vol. ii, p. 253—Vol. v, p. 742.

and Chicoplaya, Huacurachuco and the sources of the Rio Monzan, between Pataz and Pajatan, Caxamarquilla and Moyobamba. It widens greatly in the parallel of Chachapoyas, and forms a mountainous territory, traversed by deep vallies, excessively hot. The central chain, in 6° latitude, on the north of Paramo de Piscoguanuna, throws two branches towards La Vellaca and San Borja. We shall soon see that this latter branch forms, below the Rio Neva, a tributary stream of the Amazon, the rocks that border the famous Pongo de Manseriche. In this zone, where northern Peru draws near the confines of New Grenada in 10° and 5° of latitude, no summit of the eastern and central chains rises as high as the region of perpetual snows; the only snowy tops are in the western chain. The central chain, that of the Paramos de Callacalla, and Piscoguanuna, scarcely reaches 1800 toises, and lowers gently to 800 toises; so that the mountainous and tempered land which extends on the north of Chachapoyas towards Pomacocha, La Vellaca, and the source of the Rio Nieva, is still rich in fine trees of quinquina. After having passed the Rio Huallaga and the Pachitea, which with the Beni forms the Ucayali, we find in advancing towards the east, only ranges of hills. The western chain of the Andes, which is the most elevated and the nearest to the coast, stretches almost in a parallel with

the shore N. 22° W., between Caxatambo and Huary, Conchucos and Guamachuco, by Caxamarca, the Paramo de Yanaguanga and Montan, towards the Rio de Guancabamba. It presents (between 9° and 7½°) the three *Nevados* de Pelagatos, Moyopata, and Huaylillas. This last snowy summit, situated near Guamachuco, (in 7°55' latitude) merits the more particularly to fix attention, since from thence on the north, as far as Chimborazo, on a length of 140 leagues, there exists not one mountain that enters the region of perpetual snows. This depression or absence of snows, extends in this interval, over all the lateral chains, while, on the south of the Nevado de Huaylillas, we constantly observe that when one chain is very low, the summits of the other surpass the height of 2460 toises. In order to fix attention the more on the branch of the Andes which extends on the west of the Amazon, that of Conchucos and Caxamarca, I shall here repeat that it was on the south of Micuipampa (lat. 7° 1') that I found the magnetic equator.

The Amazon, or as it is customary to say in those regions, the Upper Maragnon, passes through the western part of the longitudinal valley which lies between the Cordilleras of Chachapayas, and Caxamarca. Comprehending in one point of view, this valley, and that of Rio Jauja, bounded by the Cordilleras of

Tarma and Huarocheri, we are inclined to consider them as one immense basin 180 leagues long, and crossed at the first third of its length, by a dyke, or ridge 18,000 toises broad. In fact, the two Alpine lakes of Lauricocha and Chinchaycocha, which give birth to the river of the Amazons and the Rio de Jauja, are placed south and north of this rocky dyke, formed by a prolongation of the knot of Huanuco and Pasco. The Amazon, in issuing from the longitudinal valley, that bounds the chains of Caxamarca and Chachacocha, breaks, as we have already said in another place *, the latter of those chains, which merits the name of central without being the most lofty; the point where the great river penetrates into the mountains is very remarkable. Entering the Amazon by the Rio Chamaya or Guancabamba, I found opposite the confluence, the picturesque mountain of Patachuana; but the rocks on both banks of the Amazon begin only between Tambillo and Tomependa (lat. $5^{\circ} 31'$, long. $80^{\circ} 56'$). From thence to Pongo de Rentema, a long succession of rocks follow, of which the last is the Pongo de Tayouchouc, between the strait of Manseriche and the village of San Borja. The course of the Amazon, at first directed north, and then east, changes near Pu-

* Vol. v, p. 41.

yaya, three leagues north-east of Tomependa. In the whole of this distance, between Tambillo and San Borja, the waters force a way, more or less narrow, across the sand-stone of the Cordillera of Chachapoyas. The mountains are lofty near the Embarcadero, at the confluence of the Imasa, where trunks of Cinchona, which might be easily transplanted to Cayenne, or the Canaries, approach the Amazon. The rocks in the famous strait of Manseriche, are scarcely 40 toises high; and further eastward, the last hills rise near Xeberòs, towards the mouth of the Rio Huallaga.

In order not to interrupt the description of the Cordilleras, between the 15° and $5\frac{1}{2}^{\circ}$ of latitude, between the knots of the mountains of Cuzco and Loxa, I have hitherto passed over in silence the extraordinary widening of the Andes near the Apolobamba. The sources of the Rio Beni being found in this *counter-fort*, which stretches towards the north, beyond the confluence of that river with the Apurimac, I shall designate the whole group by the name of the *counter-fort of Beni*. The following is the most certain information I have obtained respecting those countries, from persons who had long inhabited Apolobamba, the *Real* of the mines of Pasco, and the convent of Ocopa. Along the whole eastern chain of Titicaca, from La Paz to the knot of Huanuco (lat. $17\frac{1}{2}^{\circ}$ to $10\frac{1}{2}^{\circ}$) a very wide

mountainous land lies towards the east, at the back of the declivity of the Andes. It is not a widening of the eastern chain itself, but rather of the *counter-forts* of small height that follow the foot of the Andes like a penumbra, filling the whole space between the Beni and the Pachitca. A chain of hills bounds the eastern bank of the Beni to 8° of latitude; for, according to the very exact information I received from father Nacisso Gilbar, the rivers Coanache and Magua, tributaries of the Ucayali (flowing in the 6° and 7° latitude), come from a mountainous land between the Ucayali and the Javari. The existence of this land in so eastern a longitude (probably long. 74°), is so much more remarkable, as we find at four degrees of latitude further north, neither a rock nor a hill on the east of Xeberos, or the mouth of the Huallaga (long. 77° 56').

We have just seen that the counter-fort of Beni, a sort of lateral branch, loses itself towards 8° of latitude; the chain between the Ucayali and the Huallaga terminates at the parallel of 7° in joining, on the west of Lamas, the chain of Chachapayas, stretching between the Huallaga and the Amazon. Finally, the latter chain, which we have also designated by the name of central, after having formed the rapids and cataracts of the Amazon, between Tomependa and San Borja, turns towards the north-north-west,

and joins the western chain, that of Caxamarca, or the Nevados of Pelagatos and Huaylillas, and forms the *great knot of the mountains of Loxa*. The mean height of this knot is only 1000 to 1200 toises; its temperate climate renders it peculiarly fitted for the vegetation of the trees of quinquina, the finest kinds of which grow in the celebrated forests of Caxanuma and Uritusinga, between the Rio Zamora and the Cachiyacu, and between Tavacona and Guancabamba. For ages, before the quinquina of Popayan and Santa Fe de Bogota (nor. lat. $2\frac{1}{2}^{\circ}$ to 5°), of Huacarachuco, Huamalies, and Huanuco (south lat. 9° to 11°), was known, the knot of the mountains of Loxa was regarded as the sole region from whence the febrifuge bark of Cinchona could be obtained. This knot occupies the vast territory between Guancabamba, Avayaca, Oña, and the ruined towns of Zamora and Loyola, between $5\frac{1}{2}^{\circ}$ and $3\frac{1}{4}^{\circ}$ of latitude. Some of the summits (the *Paramos* of Alpachaca, Saraguru, Savanilla, Gueringa, Chulucanas, Guamani, and Yamoca, which I measured), rise from 1580 to 1720 toises, but are not as a groupe covered with snows, which in this latitude falls only above 1860 to 1900 toises of absolute height. In descending towards the east, to the Rio Santiago and the Rio of Chamaya, two tributary streams of the Amazon, the mountains lower rapidly; between San

Felipe, Matara, and Jaen de Bracamoros, they are not more than 500 or 300 toises.

As we advance from the mountains of mica-slate of Loxa towards the north, between the *Paramos* of Alpachaca and Sarar (in latitude $3^{\circ} 15'$), the knot of mountains is ramified into two branches that comprehend the longitudinal valley of Cuenca. This separation lasts on a length of only 12 leagues; for in the $2^{\circ} 27'$ of latitude, the two Cordilleras join anew in the *knot of Assuay*, a trachytic groupe, of which the table-land, near Cadlud, 2428 toises high, enters nearly into the region of perpetual snow.

At the knot of the mountains of Assuay, which affords a very frequented *passage of the Andes*, between Cuenca and Quito, succeeds (lat. $2\frac{1}{2}^{\circ}$ to $0^{\circ} 40'$ south), another division of the Cordilleras become celebrated by the labors of Bouguer and La Condamine, who have placed their signals sometimes on one, sometimes on the other of the two chains. The eastern is that of Chimborazo (3350 toises) and of Carguairazo; the western, the chain of the volcano Sangay, the Collanes, and of Llanganate. The latter is broken by the Rio Pastaza. The bottom of the longitudinal basin that bounds those two chains, from Alausi to Llactacunga, is a little higher than the bottom of the basin of Cuenca. North of Llactacunga, $0^{\circ} 40'$ latitude,

between the tops of Yliniza (2717 t.) and Cotopaxi (2950 t.), of which the former belongs to the chain of Chimborazo, and the latter to that of Sangay, is placed the *knot of Chisinche*; a kind of narrow dyke that shuts in the basin, and divides the waters between the Atlantic Ocean, and the South Sea. The *Alto de Chisinche* is only elevated 80 toises above the surrounding table-lands. The waters of the northern declivity form the Rio de San Pedro, which, joining the Rio Pita, throws itself into the Gualabamba, or Rio de las Esmeraldas. The waters of the southern declivity, designated more particularly by the name of Cerro de Tio-pullo, run to the Rio of S. Felipe and Pastaza, a tributary stream of the Amazon.

The *bipartition* of the Cordilleras recommences and continues from $0^{\circ} 40'$ of south to $0^{\circ} 20'$ of north latitude; that is, as far as the volcano of Imbabura, near the villa of Ibarra. The eastern Cordillera displays the snowy summits of Antisana (2992 toises), of Guamani, Cayambe (3070 toises), and Imbabura; the western Cordillera, those of Corazon, Atacazo, Pichincha (2491 toises), and Cotocache (2570 toises). Between these two chains, which may be regarded as the classical soil of the astronomy of the 18th century, is a valley, part of which is again divided longitudinally by the hills of Ichimbio and Poignasi. The table-lands

of Puembo and Chillo lie on the east of those hills; and those of Quito, Iñaquito, and Turubamba on the west. The equator crosses the summit of Nevado de Cayambe*, and the valley of Quito in the village of San Antonio de Lulumbamba. When we consider the small mass of the knot of Assuay, and above all, of that of Chisinche, we are inclined to regard the three basins of Cuenca, Hambato, and Quito, as one long valley (from the Paramo de Sarar to the Villa de Ibarra) of 73 marine leagues, 4 or 5 leagues broad, having a general direction N. 8° E. and divided by two transversal dykes, one between Alausi and Cuenca ($2^{\circ} 27'$ south latitude), and the other between Machache and Tambillo ($0^{\circ} 40'$). No where in the Cordillera of the Andes are more colossal mountains heaped together, than on the east and west of this vast basin of the province of Quito, one degree and a half south, and a quarter of a degree north of the equator. This basin, the centre of the most ancient native civilization, after that of the basin of Titicaca, touches towards the south, the knot of the mountains of Loxa, and towards the north, the table-land of the province of Los Pastos.

* The heights of Chimborazo, Rucupichincha, Cayambe, and Antisana, which are different from those stated by La Condamine, in the inscription at the convent of Jesuits at Quito, are the result of my own geodesic measurements.

In this province, a little beyond the Villa of Ibarra, between the snowy summits of Coto-cache and Imbabura, the two Cordilleras of Quito join, and form one mass, extending to Meneses and Voisaco, from $0^{\circ} 21'$ nor. lat. to $1^{\circ} 13'$. I call this mass, on which the volcanoes of Cumbal and Chiles rise, the *knot of the mountains of Los Pastos*, on account of the name of the province that forms the center. The volcano of Pasto, of which the last eruption took place in the year 1727, is on the south of Yenoï, near the northern limit of this groupe, of which the inhabited table-lands are more than 1600 toises above the level of the Ocean. It is the Thibet of the equinoxial regions of the New World.

On the north of the town of Pasto (north latitude $1^{\circ} 13'$; long. $79^{\circ} 41'$), the Andes again divide into two branches, and surround the table-land of Mamendoy and Almaguer. The eastern Cordillera contains the Sienega of Sebondoy (an alpine lake that gives birth to the Putumayo), the sources of the Jupura or Caqueta, and the Paramos of Aponte and Iscanse. The western Cordillera, that of Mamacondy, called in the country *Cordillera de la Costa*, on account of its proximity to the shore of the South-Sea, is broken by the great Rio de Patias, which receives the Guativa, the Guachicon, and the Quilquase. The table-land or intermediary basin has great inequalities; it is partly filled

by the Paramos of Pitatumba and Paraguay, and the separation of the two chains appeared to me indistinct as far as the parallel of Almaguer (lat. $1^{\circ} 54'$; long. $79^{\circ} 15'$). The general direction of the Andes, from the extremity of the basin of the province of Quito to the vicinity of Popayan, changes from N. 8° E. to N. 36° E.; and follows the direction of the coast of Esmeraldas and Barbacoas.

On the parallel of Almaguer, or rather a little north-east * of that town, the geological constitution of the land displays very remarkable changes. The Cordillera, which we have just marked by the name of the eastern, that of the lake of Sebondoy, widens considerably between Pansitara and Ceja. The knot of the *Paramo de las Papas and of Socoboni*, gives birth to the great rivers of Cauca and Magdalena, and is divided into two chains, latitude $2^{\circ} 5'$ on the east and west of la Plata Vieja and Timana. These two chains remain nearly parallel as far as 5° of latitude, and bound the longitudinal valley through which winds the Rio Magdalena. We shall give the name of the *eastern Cordillera of New Grenada*, to that which stretches towards Santa Fe de Bogota, and the Sierra Nevada de Merida, east of Magdalena; that of *central Cor-*

* See my map of the Rio Magdalena, pl. 24 of the *Atlas géographique et physique*.

dillera of New Grenada, to that which lies between the Magdalena and the Cauca, towards Mariquita; and that of the *western Cordillera of New Grenada*, to the chain which continues the *Cordillera de la Costa* from the basin of Almaguer, and separates the bed of the Rio Cauca from the platiniferous territory of Choco. In order to be clearer, we may also name the first chain, that of Suma Paz, after the colossal groupe of mountains on the south of Santa Fe de Bogota, which throws the waters of its eastern declivity into the Rio Meta. The second chain may bear the name of the chain of *Guanacas* or Quindiu, on account of the two celebrated passages of the Andes, in the way from Santa Fe de Bogota to Popayan. The third chain may be called that of *Choco*, or of the *shore*. Some leagues on the south of Popayan (nor. lat. $2^{\circ} 21'$), west of Paramo de Palitara and the volcano of Purace, a ridge of micaslate runs from the *knot of the mountains** of *Sacomboni*, towards the north-west, and divides the waters between the South Sea and the Caribbean Sea; they flow from the northern declivity into the Rio Cauca, and from the southern declivity, into the Rio de Patias.

The *tripartition* of the Andes, which we have

* See my *Essai géogn. sur le gisement des roches*, p. 130 and 131.

just stated, (nor. lat. $1\frac{3}{4}^{\circ}$ — $2\frac{1}{4}^{\circ}$) reminds the geognost of that which takes place at the source of the Amazon in the *knot of the mountains of Huanuco and Pasco* (south lat., 11°); but the most western of the three chains that bound the basins of the Amazon and the Hualaga, is the loftiest; while that of Choco, or the shore, is the least elevated of the three chains of New Grenada. It is ignorance of this tripartition of the Andes in that part of South America near the Rio Atrato and the isthmus of Panama, which has led to so many erroneous judgments on the possibility of a canal of junction between the two seas*.

The eastern chain of the Andes of New Grenada, (I employ a systematic denomination, for the name of the Andes is unknown in the countries situated north of the equator,) the eastern chain preserves its parallelism during some time with the two other chains, those of Quindiu and Choco; but beyond Tunja (lat. $5\frac{1}{2}^{\circ}$), it inclines more towards the north-east, passing somewhat abruptly from the direction N. 25° E. to that of N. 45° E. It is like a vein that changes its direction, and rejoins the coast after an extraordinary enlargement which it undergoes by the grouping of the snowy mountains of Merida. The tripartition of the Cor-

* See above, Vol. vi, p. 248.

dilleras, and above all, the spreading of their branches, have a powerful influence on the prosperity of the nations of New Grenada. The diversity of the superposed table-lands and climates varies the agricultural productions as well as the character of the inhabitants; it gives activity to the exchange of products, and renews on a vast surface, on the north of the equator, the picture of the sultry vallies, and the cold and temperate plains of Peru. It is also worthy of remark that, by the separation of one of the branches of the Cordilleras of Cundinamarca, and the deviation of the chain of Bogota towards the north-east, the colossal groupe of the mountains of Merida is enclosed in the territory of the *ancient Capitania-general* of Venezuela, and that the continuity of the same mountainous land from Pamplona to Barquesimeto and Nirgua, has, it may be said, facilitated the political union of the Columbian territory. As long as the central chain (that of Quindiu) displays its snowy summits, no peak of the eastern chain (that of La Suma Paz) rises, in the same parallels, to the limit of perpetual snows. Between 2° and $5\frac{1}{2}^{\circ}$ of latitude, neither the Paramos, situated on the east of Gigante and Neiva, nor the tops of la Suma Paz, Chingasa, Guachaneque, and Zoraca, surpass the height of 1900 to 2000 toises; while on the north of the parallel of Paramo d'Erve

* (lat. $5^{\circ} 5'$), the last of the Nevados of the central Cordillera, we discover in the eastern chain the snowy summits of Chita (lat. $5^{\circ} 50'$), and of Mucuchies (lat. $8^{\circ} 12'$). It thence results, that from 5° latitude, the only mountains covered with snow during the whole year, are the Cordilleras of *the east*; and although the Sierra Nevada of Santa Marta is not, properly speaking, a continuation of the Nevados of Chita and Mucuchies (west of Patute, and east of Merida), it is at least very near their meridian.

Arrived at the northern extremity of the Cordilleras, comprehended between Cape Horn and the isthmus of Panama, we shall confine ourselves to the indication of the loftiest summits of the three chains † which separate in the *knot of the mountains of Socoboni*, and the *ridge of Roble* (lat. $1^{\circ} 50' - 2^{\circ} 20'$). I begin with the most eastern chain, that of Timana and Suma Paz, which divides the tributary streams of the Magdalena and the Meta; it stretches by the Paramos de Chingasú, Guachaneque, Zoraca, Toquillo (near Labranza Grande), Chita, Almorsadero ‡, Laura, Cacota,

* The snows called at Santa Fe, *Mesa de Herveo*.

† See above, 248.

‡ This Paramo is situated between the bridge of Chitaga and the village of Tequia. The Rio Chitaga throws itself into the Sarare, and the Rio Tequia, into the Rio Sogamozo.

Zumbador, and Porqueras, towards the Sierra Nevada de Merida. These Paramos indicate ten partial risings of the back of the Cordilleras. The declivity of the eastern chain is extremely rapid on the eastern side, where it bounds the basin of the Meta and the Oroonoko; it is widened on the west by the counterforts, on which are situated the towns of Santa Fe de Bogota, Tunja, Sogamoso, and Leiva. They are like table-lands fixed to the western declivity, and which are from 1300 to 1400 toises high; that of Bogota, (the bottom of an ancient lake), contains bones of Mastodontes, in the Campo de Gigantes, near Suacha.

The intermediary, or central chain, runs on the east of Popayan, by the high plains of Mabasa, the Paramos of Guanacas, Huila, Savelillo, Iraca, Baraguan, Tolima *, Ruiz, and Herveo, towards the province of Antioquia. In the 5° 15' of latitude, this chain, the only one that displays recent traces of volcanic fire, in the

The Paramos of the Almosadero and Toquillo are the most lofty summits which, on the road from Merida to Santa Fe de Bogota, do not enter the region of perpetual snows. MM. Rivero and Boussingault found that the Paramo of Almosadero is passed at the elevation of 2010 toises, and the Paramo of Cacota at 1700 toises.

* The passage of the Montana de Quindiu, on the road from Ibaque to Carthago, is between the Nevados of Tolima, and Baraguan.

summits of Sotara and Purace, widens considerably towards the west, and joins the western chain, which we have called the chain of Choco, because the planitiferous land of that province lies on the slope opposite the Pacific Ocean. By the union of the two chains, the basin of the province of Popayan is shut on the north of Cartago Viejo, and the river of Cauca, in issuing from the plain of Buga, is forced, from the Salto de San Antonio, to la Boca del Espiritu Santo, to open its way across the mountains, during a course of from 40 to 50 leagues. The difference of the level is very remarkable, in the bottom of the two parallel basins of Cauca and Magdalena. The former, between Cali and Cartago, is from 500 to 404 toises ; the latter, from Neiva to Ambalema, is from 265 to 150 toises high. It might be said, according to different geological hypotheses, either that the secondary formations were not accumulated to the same thickness between the eastern and central, as between the central and western chains ; or, that the deposits have been made on the base of primitive rocks, unequally heaped up on the east and west of the Andes of Quindiu. The mean difference of this thickness of formation, or of these heights, is 300 toises. The rocky ridge of the Angostura of Carare, branches from the south-east, from the counter-fort of Muzo, through which winds the Rio Negro.

By this counter-fort, and by those that come from the west, the eastern and central chains approach between Nares, Honda, and Mendales. In fact, the bed of the Rio Magdalena is narrowed in 5° and $5^{\circ} 18'$, by the mountains of Sergento on the east, and by the counterforts that are linked with the granitic mountains of Mariquito and S. Ana, on the west. This narrowing of the bed of the river is in the same parallel with that of the Cauca, near the Salto de San Antonio; but, in the knot of the mountains of Antioquia, the central and western chains join each other, while between Honda and Mendales, the tops of the central and eastern remain so far removed, that it is only the counter-forts of each system that draw near and are confounded together. It is also worthy of remark, that the central Cordillera of New Grenada displays the loftiest summit of the Andes in the northern hemisphere. The peak of Tolima * (lat. $4^{\circ} 46'$), of which the name is almost unknown in Europe, and which I measured in 1801, rises at least 2865 toises high. It consequently surpasses the Imbabura, and the Cotocache in the province of Quito, the Chiles of the table-lands of los Pastos, the two volcanoes of Popayan,

* The second rank of height, in the northern hemisphere, appears to be occupied by the *Nevado de Huila* (lat. $2^{\circ} 55'$), between Nataga and Quilichao. M. Caldas estimates it 2800 toises. (See *Semanario de Bogota*, Tom. i, p. 6.)

and even the Nevados of Mexico and the Mount Saint Elie of Russian America. The peak of Tolima, which in form resembles Coto-paxi, yields perhaps in height only to the ridge of the Sierra Nevada de Santa Marta, which may be considered as an insulated system of mountains.

The eastern chain, also called *chain of Choco and the coast* (of the South Sea), separates the provinces of Popayan and Antioquia from those of Barbacoas, Raposo, and Choco. Little elevated in general, if compared to the height of the central and eastern chains, it however presents great obstacles to the communications between the valley of Cauca and the shore*. On its western slope lies the famous *auriferous* and *platiniferous* land †, which has during

* The frightful roads that cross the western chain, are those of Chisquio (east of the Rio Micay), Anchicaya, las Juntas, Saint Augustin, opposite Cartago, Chami, and Urrao. (*Seman.*, Tom. i, p. 32.)

† The Choco Barbacoas and Brazil are the only countries of the earth where the existence of grains of platina and of palladium has been hitherto fully ascertained. The small town of Barbacoas is situated on the left bank of the Rio Telembi (tributary of Patias or the Rio del Castigo), a little above the confluence of Telembi and the Guagui or Guaxi, nearly in 1° 48' of latitude. The ancient *Provincia*, or rather the *Partido del Rasposo*, comprehends the insalubrious land extending from the Rio Dagua, or San Buenaventura to the Rio Iscuande, the southern limit of Choco.

ages yielded more than 13,000 marks of gold annually to commerce. This alluvial zone is from 10 to 12 leagues broad : it attains its maximum of riches between the parallels of 2° and 6° of latitude, is sensibly impoverished towards the north and south, and almost entirely disappears between 14° of north latitude and the equator. The auriferous soil fills the basin of Cauca, as well as the ravines and plains on the west of the Cordillera of Choco ; it rises sometimes nearly 600 toises above the level of the sea, and descends at least 40 toises *. Platina (and this geognostic fact is worthy of attention), has hitherto been found *only on the west* of the Cordillera of Choco, and not on the east, notwithstanding the analogy of the fragments of rocks, of greenstone, phonolite, trachyte, and ferruginous quartz, of which the soil of the two descents is composed. From the ridge of Los Robles, which separates the table-land of Almaguer from the basin of Cauca, the western chain forms, first, in the Cerros of Carpinteria, east of the Rio San Juan de Micay, the continuation of the Cordillera of Sindagua, broken by the Rio Patias ; then, lowers towards the north, between Cali and Las Juntas de Dagua, to from

* M. Caldas assigns to the *upper limit of the zone of gold washings*, only the height of 350 toises. (*Seman.*, Tom. i, p. 18) ; but I found the *lavaderos* of Quilichao, on the north of Popayan, 565 toises high. (*Astron. Obs.*, Vol. i, p. 303.)

800 to 900 toises of height, and sends considerable counter-forts (in $4\frac{1}{4}^{\circ}$ — 5° of latitude) towards the source of the Calima, the Tamana, and the Andagueda. The two former of these auriferous rivers are tributary streams of the Rio San Juan del Choco; the second empties its waters into the Atrato. This widening of the western chain forms the mountainous part of Choco: here, between the Tado and Zitara, called also Francisco de Quibdo, lies the isthmus of Raspadura, become celebrated since a monk traced on it a navigable line between the two oceans *. The culminant point of this system of mountains appears to be the Peak of Torra, situated on the south-east of Novita †.

The northern extremity of this widening of the Cordillera of Choco, which I have just described, corresponds with the junction of the same Cordillera towards the east, with the central chain, that of Quindiu. The mountains of Antioquia, on which we have the excellent observations of Mr. Restrepo ‡, may be called a *knot of*

* See above, Vol. vi, p. 260.

† I am surprized that M. Pombo has compared the *Torra del Choco*, which does not enter into the region of snows, not even perhaps into that of the Paramos (see above, Vol. v, p. 742), to the colossal mountains of Mexico. (*Noticias varias sobre las Quinas*, 1814, p. 67.)

‡ *Semanario de Bogota*, Tom. ii, p. 41—96. This memoir contains at the same time, the results of astronomical observations, the measures made with the barometer, and statistic statements on the productions and trade of this in-

mountains, because on the northern limit of the plains of Buga, or the basin of Cauca, they join the central and western chains. We have seen above, that the ridge of the eastern Cordillera remains separated by 35 leagues of distance from the knot, so that the narrowing of the bed of the Rio Magdalena, between Honda and Ambalema, results only from the approximation of the counter-forts of Mariquita and Guaduas. There is not therefore, properly speaking, a groupe of mountains, between 5° and $5\frac{1}{4}^{\circ}$ of latitude, uniting at the same time the three chains. In the groupe of the province of Antioquia, which forms the junction of the central and western Cordilleras, we may distinguish two great masses, one, between the Magdalena and the Cauca, the other, between the Cauca and the Atrato. The first of these masses is linked most immediately to the snowy summits of Herveo; it gives birth on the east, to Rio de la Miel, and the Nare; and towards the north, to Porce and Nechi; its mean height is only from 1200 to 1350 toises. The culminant point appears to be placed near Santa Rosa, south-west of the celebrated valley of Bears. (*Valle de Osos*.) The towns of Rio Negro and

teresting province, of which I attempted to trace, in 1816, the first geographical map, from the labors of M. Manuel Jose de Restrepo. (See 24th Pl. of my *Atlas*.)

Marinilla are built on table-lands 1060 toises high. The western mass of the knot of the mountains of Antioquia, between the Cauca and the Atrato, gives rise, on its western descent, to the Rio San Juan, Bevara, and Murri. It attains its greatest height (and that of the whole province of Antioquia) in the *Alto del Viento*, north of Urrao, known to the first *Conquistadores* by the name of the Cordilleras of Abide*, or Dabeida. This height (lat. $7^{\circ} 15'$), does not however exceed 1500 toises. In following the western slope of this system of mountains of Antioquia, we find that the point of partition of the waters that flow towards the South Sea, and the Caribbean Sea (in $5\frac{1}{2}^{\circ}$ and 6° of latitude) corresponds nearly with the parallel of the isthmus of Raspadura, between the Rio San Juan and the Atrato. It is remarkable that, in this groupe more than 30 leagues broad, destitute of sharp summits, between $5\frac{1}{4}^{\circ}$ and 7° of latitude, the highest masses rise towards the west; while, further south, before the union of the two chains of Quindiu and Choco, we saw them on the east of Cauca.

The ramifications of the knot of Antioquia, on the north of the parallel 7° are very imper-

* Sierra de Abide of the geographer La Cruz, with the pretended volcano of Ebojito. (See above, vol. vi, p. 260, note.)

fectly known; it is observed only that their lowering is in general more rapid and complete towards the N.W., on the side of the ancient province of Biruquete * and Darien, than towards the N. and N. E., on the side of Zaragoza and Simiti. From the northern bank of the Rio Nare, near its confluence with the Samana, a counter-fort stretches out, known by the name of la Simitarra, and the mountains of San Lucar. We shall call it the *first branch* of the groupe of Antioquia. I saw it, in going up the Rio Magdalena, on the west, from the Regidor and the mouth of the Rio Simiti, as far as San Bartolome (on the south of the mouth of the Rio Sogamozo); while, towards the east, in $7\frac{1}{4}^{\circ}$ and $8\frac{1}{4}^{\circ}$ of latitude, the counter-forts of the mountains of Ocana † appear in the distance; they are inhabited by some tribes of Molitone Indians. The *second branch* of the groupe of Antioquia (west of Samitarra) proceeds from the mountains of Santa Rosa, stretches between Zaragoza and Caceres, and terminates abruptly, at the confluence of the Rio Nechi (lat. $8^{\circ} 33'$), at least if the hills, often conical ‡, between the

* See vol. vi, p. 249, note.

† The mountains of Ocaña, linked to the Sierra de Perija, branch from the eastern chain (that of Suma Paz) on the N. W. of Pamplona.

‡ I saw in sailing the *Tettas* of Cispata, Santero, Tolu, and San Martin (lat. $9^{\circ} 18' - 9^{\circ} 32'$).

mouth of the Rio Simu and the small town of Tolu, or even the calcareous heights of Turbaco and Popa, near Carthagena, may not be regarded as the most northern prolongation of this second branch. A *third*, advances towards the gulph of Uraba* or Darien, between the Rio San Jorge and the Atrato. It is linked towards the south, with the *Alto del Viento*, or Sierra de Abide, and is rapidly lost, in advancing as far as the parallel of 8°. Finally, the *fourth branch* of the Andes of Antioquia, placed on the west of Zitara and the Rio Atrato, undergoes, long before it enters the isthmus of Panama, such a depression, that between the gulph of Cupica, and the embarcadere of the Rio Naipipi, we find only a plain† across which M. Gogueneche has projected a canal of junction of the two seas. It would be interesting to know the configuration of the soil between cape Garachine, or gulph of St. Miguel, and cape Tiburon, above all, towards the source of the Rio Tuyra and Chucunaque, or Chucunque, in order to determine with precision where the mountains of the isthmus of Panama begin to rise, mountains of which the elevation does not appear to be above 100 toises high. The interior of Dar-

* See above, Vol. vi, p. 331 ; and *Semanario de Bogota*, Tom. ii, p. 83.

† Vol. vi, p. 256.

four is not more unknown to geographers, than the humid, insalubrious land, covered with thick forests, which extends on the north-west of Betoï and the confluence of Bevara with the Atrato, towards the isthmus of Panama. All that we hitherto know positively, is, that between Cupica and the left bank of the Atrato, there is either a *land-strait*, or a total absence of the Cordillera. The mountains of the isthmus of Panama may, by their direction and their geographical position, be considered as a continuation of the mountains of Antioquia and Choco; but on the west of Bas-Atrato, there scarcely exists a ridge in the plain. We do not find in this country a groupe of interposed mountains like that which indubitably links (between Barquesimeto, Nirgua, and Valencia) the eastern chain of New Grenada (that of Suma Paz and the Sierra Nevada de Merida) to the Cordillera of the shore of Venezuela.

In order the better to impress on the memory the results of my laborious researches on the structure and configuration of the Andes, I shall collect them in the form of a table, beginning with the most southern part of the New Continent. We shall see that the Cordillera of the Andes, considered in its whole extent, from the rocky breaker of Diego Ramirez, as far as the isthmus of Panama, is sometimes ramified into chains more or less

parallel, and sometimes *articulated* by immense *knots of mountains*. We distinguish nine of those knots, and consequently an equal number of branching points and ramifications. The latter are generally bifurcations: the Andes are twice only divided into three chains, in the knot of Huanuco, near the source of the Amazon, and the Huallaga, (lat. 10° to 11°), and in the knot of the Paramo de las Papas (lat. 2°), near the source of the Magdalena and the Cauca. *Basins*, almost shut in at their extremities, parallel to the axis of the Cordillera, and bounded by two knots and two lateral chains, are characteristic features of the structure of the Andes. Among these knots of mountains, some, for instance those of Cuzco, Loxa, and Los Pastos, are 3300, 1500, and 1130 square leagues, while others no less important in the eyes of the geologist are restrained to ridges or transversal dykes. To the latter belong the Altos de Chisinche (lat. $0^{\circ} 40'$ south), and the Los Robles (lat. $2^{\circ} 20'$ north), on the south of Quito and Popayan. The knot of Couzco, so celebrated in the annals of Peruvian civilization, presents a mean height of from 1200 to 1400 toises, and a surface nearly three times greater than the whole of Switzerland. The ridge of Chisinche, which separates the basins of Tacunga and Quito, is 1580 toises of absolute height, but scarcely a mile broad. The knots or groupes

which unite several partial chains, have not the highest summits, either in the Andes, or, for the most part, in the great Cordilleras of the ancient continent; it is not even certain that there is always in those knots a widening of the chain. The greatness of the mass, and the height so long attributed to points whence several considerable branches issue, was founded either on theoretic prejudices, or on false measures. Men amused themselves by comparing the Cordilleras to rivers that swell as they receive a number of tributary streams.

| SOUTHERN HEMISPHERE. | KNOTS AND CHAINS OF THE ANDES IN SOUTH AMERICA. |
|-------------------------|--|
| Lat. 56° 33' | Rock of Diego Ramirez. Cape Horn. Patagonian Andes. Vestiges of the rocky isles of Huaytecas and Chonos. Cordilleras of Chili, reinforced on the east by the three |
| Lat. 33°—31° | Counter-forts of the Sierra de Cordova. |
| Lat. 27°—23° | of the Sierra de Salta. |
| Lat. 22°—18° | of the Sierra de Cochabamba and Santa Cruz. |
| Lat. 20½°—19½° | KNOT OF PORCO AND POTOSI. Division in two chains, east and west of the basin of Titicaca : Eastern chain, \| Western chain, or la Paz and Palca. \| or Tacna and Arequipa. |
| Lat. 15°—14° | KNOT OF COUZCO. Two chains, east and west of Rio Jauja, widened towards the east by the counter-fort of Beni. Eastern chain, \| Western chain, or of Ocopa and Tar- \| or of Huancavelica. ma. |
| Lat. 11°—10½° | KNOT OF HUANUCO AND PASCO. Ramification in three chains separated by the basins of Huallaga and the Upper Maragnon. Eastern chain, \| Central chain, or of Pozuzu and Mu- \| or of Pataz and Cha- ña. \| chapoyas. Western chain, or of Guamachuco and Caxamarca. |
| Lat. 5¼°—3¼° | KNOT OF LOXA. Two chains, east and west of the basin of Cuenca. |

| SOUTHERN HEMISPHERE. | KNOTS AND CHAINS OF THE ANDES IN SOUTH AMERICA. |
|--|--|
| Lat. $2^{\circ} 27'$ | KNOT OF ASSUAY. Two chains, on the east and west of the basin of Alausi and Hambato. Eastern chain, Western chain, or of Cotopaxi. or of Chimborazo. |
| Lat. $0^{\circ} 40'$ | KNOT (or rather ridge) OF CHISINCHE. Two chains, on the east and west of the valley of Quito. Eastern chain, Western chain, or of Antisana. or of Pichincha. |
| NORTHERN HEMISPHERE. | The equator passes on the summit of Cayambe (belonging to the eastern chain or of Antisana.) |
| Lat. $\frac{1}{2}^{\circ} - 1\frac{1}{4}^{\circ}$ | KNOT OF LOS PASTOS. Ramification in two chains, on the east and west of the table-land of Almaguer. |
| Lat. $1^{\circ} 55' - 2^{\circ} 20'$ | KNOT OF THE SOURCES OF THE MAGDALENA AND THE RIDGE OF LOS ROBLES. Three chains, divided by the basins of the Magdalena and Cauca. Eastern chain, Central chain, or of Timana, Suma or of Guanacas, Quin- Paz, Chita, & Me- diu, and Erve. rida. Western chain, with the platiniferous land of Choco. |

 NORTHERN
HEMISPHERE.

 KNOTS AND CHAINS OF THE ANDES IN SOUTH
AMERICA.

Lat. $5\frac{1}{2}^{\circ}$ — 7° KNOT OF THE PROVINCE OF ANTIOQUIA in which only the chains of Quindiu and Choco join. The eastern chain approaches by *counter-forts* towards Honda.

Lat. 7° — 9° Ramification of the knot of the mountains of Antioquia into four branches : 1st. of Simitarra ; 2d. of Caceres, Nechi, and Altos de Tolu ; 3d. between the Rio S. Jorge and the Atrato ; 4th. on the west of the Atrato. This last branch, extremely low, appears to be linked at the utmost by an inconsiderable ridge, (*seuil*,) to the mountainous groupe of the isthmus of Panama. The eastern chain of the Andes of New Grenada, that of Suma Paz, and the Sierra Nevada of Merida, remains separated from the Sierra Nevada of Santa Marta, by the plains of Rio Cesar ; but it joins, by the mountains Barquesimeto and Nirgua, the Cordillera of the shore of Venezuela, of which the culminant points are the Silla de Caraccas, the Bergantin, the Turimiquiri, and the promontory of Paria.

Among the basins which the sketch of the Andes presents, and which form probably as many lakes or small interior seas, the basins of Titicaca, Rio Jauja, and the Upper Maragnon, have respectively 3500, 1300, and 2400 square leagues of surface *. The first is so inclosed, that no drop of water can escape except by evaporation ; it is a repetition of the shut up valley of Mexico †, and of those numerous circular basins which are discovered in the moon, and are sur-

* I shall state in this note the whole of those estimates which interest geologists. *Area* of the Andes, from the Land of Fire to the Paramo of las Rosas (lat. $9\frac{1}{4}^{\circ}$ nor.), where the mountainous land of Tucuyo and Barquesimeto begins, part of the Cordillera of the shore of Venezuela, 58,900 square leagues, 20 to a degree ; the four counterforts of Cordova, Salta, Cochabamba, and Beni alone, occupy 23,300 square leagues of this surface, and the three basins contained between the 6° and 20° of south latitude, 7200 square leagues. Deducting 33,200 square leagues for the whole of the inclosed basins and counterforts, we find in 65° of latitude, the area of the Cordilleras elevated in the form of walls, to be 25,700 square leagues, whence results (comprehending the knots, and admitting the inflexion of the chains,) a mean breadth of the Andes of 18 to 20 leagues. (See above, p. 409.) The valleys of Huallaga and the Rio Magdalena are not comprehended in these 58,900 square leagues, on account of the diverging direction of the chain, east of Chicoplaya and Santa Fe de Bogota.

† We consider it in its primitive state, without respect to the trench or cleft of the mountains, known by the name of *Desague de Huehuetoca*.

rounded by lofty mountains. An immense Alpine lake characterizes the basin of Tiahuanaco, or Titicaca; this phenomenon is so much more worthy of attention, as in South America those reservoirs of fresh water are almost entirely wanting, which are found at the foot of the Alps of Europe, on the northern and southern descent, and which are permanent during the season of drought. The other basins of the Andes, for instance, those of Jauja, the Upper Maragnon, and Cauca, pour their waters into natural canals, which may be considered as so many crevices placed either at one of the extremities * of the basin, or on its banks †, nearly in the middle of the lateral chain. It was proper to dwell on this *articulated form* of the Andes, on those knots or transversal ridges, and that long succession of inland basins, from Potosi in Upper Peru, as far as Salto de San Antonio in the province of Antioquia, because, in the continuation of the Andes called the Cordilleras of the shore of Venezuela, we shall find the same transversal dykes, and the same phenomena.

The ramification of the Andes and of all the

* Basin of the Amazon and Cauca.

† Basin of Tarma or the Rio Jauja, broken laterally on the east by the Mantaro. Basin of Almaguer, broken laterally on the west by the Rio de Patias.

great masses of mountains into several chains, merits particular consideration with respect to the height more or less considerable of the bottom of the inclosed basins, or longitudinal vallies. Geologists have hitherto been much more occupied by the successive narrowing of these basins, their depth compared with the walls of rock that surround them, and the correspondence between the re-entering and salient angles, than by the level of the bottom of the vallies. No precise measure yet indicates the absolute height of the three basins, of Titicaca, Jauja, and the Upper Maragnon *; but I was fortunate enough to be able to determine the six other basins, or longitudinal vallies, which succeed each other, as by steps, towards the north. The bottom of the valley of Cuenca, between the knots of Loxa and Assuay, is 1350 toises; the valley of Alansi and of Hambato, between the knot of the Assuay and the ridge of Chisinche, 1320 toises; the valley of Quito † in

* I am inclined to believe that the southern part of the basin of the Upper Maragnon, between Huary and Huacarachuco, surpasses at least 350 toises; for I found the mean waters of Maragnon, near Tomependa, 194 toises above the level of the Ocean; and, according to the analogy of the course of the Magdalena, between Neiva and the Angostura of Cavare, the Upper Maragnon, may in a course of 4° of latitude, have a fall of 150 toises.

† The valley of Quito, Iñaquito, and Turubamba, ought to

the eastern part, 1340 toises ; and in the western part 1490 toises ; the basin of Alinaguer 1160 toises ; the basin * of the Rio Cauca, between the lofty plains of Cali, Buga, and Cartago, 500 toises ; the valley of Magdalena, first between Neiva and Honda, 200 toises ; and further on, between Honda and Mompox, 100 toises of mean height above the level of the sea †. In

be geognostically considered as the same valley as that of Puembo and Chillo. The interposed hills of Ichimbio and Poingasi mask this communication.

* In order to compare this basin, which is the most fertile part of the province of Popayan, and the basin of the Magdalena with those of the ancient continent, I shall here mention the table-lands of Mysore in India (420 to 470 toises) ; the interior of Spain (350 toises) ; of Switzerland between the Alps and the Jura (270 toises) ; of Bavaria (260 toises), and of Swabia (150 toises).

† In the region of the Andes comprehended between 4° of south latitude and 2° of north, the *longitudinal vallies*, or basins inclosed by parallel chains, are regularly between 1200 and 1500 toises high ; while the transversal vallies are remarkable for their depression, or rather the rapid lowering of their bottom. The valley of Patias, for instance, running from N. E. to S. W. is only 350 toises of absolute height even above the junction of the Rio Guachicon with the Quilquasi, according to the barometric measures of Mr. Caldas ; and yet it is surrounded by the highest summits, the Paramos de Puntaurcu and Mamacondy. (*Seman. Tom. i, p. 28, and Tom. ii, p. 140.*) In going from the plains of Lombardy, and penetrating into the Alps of the Tyrol, by a line perpendicular to the axis of the chain, we advance more than 20 marine leagues towards the north, yet we find the

this region, which has been measured with precision, the different basins lower from the equator, very sensibly towards the north. In general the elevation of the bottom of the inclosed basins merits great attention from those who reflect on the causes of the formation of the vallies. I do not deny that the depressions in the plains may be sometimes the effect of ancient pelagic currents, or slow erosions. I am inclined to believe that the transversal vallies, resembling crevices, have been widened by running waters; but these hypotheses of *successive erosions* cannot well be applied to the completely inclosed basins of Titicaca and Mexico. These basins, as well as those of Jauja, Cuenca, and Almaguer, which lose their waters only by a lateral and narrow issue, are owing to a cause more instantaneous, more closely linked

bottom of the valley of the Adige and of Eysack near Botzen, to be only 182 toises of absolute height, an elevation which exceeds but 117 toises that of Milan. (*See above, Vol. iv, p. 311.*) From Botzen however, to the ridge of Brenner (culminant point of 746 toises), is only 11 leagues. The Valais is a longitudinal valley; and in a barometric measurement which I made very recently from Paris to Naples and Berlin, I was surprised to find that from Sion to Brigg, the bottom of the valley only rises to from 225 to 350 toises of absolute height; nearly the level of the plains of Switzerland, which, between the Alps and the Jura (for instance, between Berne, Thoun and Fribourg), are only from 274 to 300 toises.

with the heaving-up of the whole chain. It may be said that the phenomenon of the steep or narrow declivities of Sarental and of the valley of Eysack in the Tyrol, is repeated at every step, and on a greater scale in the Cordilleras of equinoxial America. We seem to recognize those longitudinal sinkings, those "rocky vaults," which, to use the expression of a great geologist *, "are broken when extended over a great space, and leave deep and almost perpendicular rents."

If, to complete the sketch of the structure of the Andes, from the Land of Fire to the northern Polar Sea, we pass the limits of South America, we see the western Cordillera of New Grenada, after a great depression between the mouth of the Atrato and the gulph of Cupica, again rise in the isthmus of Panama to 80 or 100 toises high †, augmenting towards the west, in the Cordilleras of Veragua and Salamanca ‡,

* *Leopold de Buch, Tableau du Tyrol meridional, 1823, p. 8.*

† *See above, Vol. vi, p. 254, 255.*

‡ If what navigators affirm be true, that the mountains at the N. W. extremity of the republic of Columbia, and known by the names of Silla de Veragua, and Castillo del Choco (in the meridian of the Boca del Toro, and la Laguna Chiriqui), are visible at 36 leagues distance (*Pardy, Columbian Navigator, p. 134*), the elevation of their summits must be nearly 1400 toises, and would differ little from that of the Silla de Caraccas.

and extending by Guatemala, as far as the confines of Mexico. In this space it remains constantly near the coast of the South Sea, where, from the gulph of Nicoya to Soconusco (lat. $9\frac{1}{2}^{\circ}$ — 16°), is found a long series of volcanoes *, most frequently insulated, and sometimes linked to counter-forts or lateral branches. Passing the isthmus of Tehuantepec or Huasacualco, on the Mexican territory, the Cordillera of *central America* remains in the intendance of Oaxaca, at an equal distance from the two oceans ; and then in $18\frac{1}{2}^{\circ}$ to 21° of latitude, from Misteca to the mines of Zimapan, draws near the eastern coast. It attains nearly in the pa-

* See the list of twenty-one volcances of Guatemala, partly extinguished, and partly still burning, given by Mr. Arago and myself, in the *Annuaire du Bureau des longitudes pour 1824*, p. 175. No mountain of Guatemala having been hitherto measured, it is so much the more important to fix approximatively the height of the *Volcan de agua* placed between the Volcano of Pacaya, and the *Volcan de Fuego*, called also *Volcano of Guatemala*. Mr. Juarros expressly says, that this volcano, which destroyed by torrents of water and stones, on the 11th September, 1541, the Ciudad Vieja, or Almolonga, (the ancient capital of the country, which must not be confounded with the Antigua Guatemala), is covered with snow during several months of the year. This phenomenon seems to indicate a height of more than 1750 toises. (*Compendio de la Hist. de Guatemala*, Tom. i, p. 72—85 ; Tom. ii, p. 351. *Remesal, Hist. de la Province de San Vicente*, lib. iv, cap. 5.)

rallel of the town of Mexico, between Toluca, Xalapa, and Cordoba, its maximum of height; there, several colossal summits rise to 2400 and 2770 toises. Farther north, the chain called Sierra Madre* runs N. 40° W. towards San Miguel el Grande and Guanaxuato. Near the latter town (lat. $21^{\circ} 0' 15''$), where the richest silver mines of the known world are found, it takes an extraordinary breadth, and is divided into three branches. The most eastern advances towards Charcas and the Real de Catorce, and lowers progressively (turning to the N.E.) in the ancient kingdom of Leon, in the province of Coahuila and Texas. That branch stretches from the Rio Colorado de Texas, crossing the Arkansas, (on the west of Arkopolis) towards the confluence of the Mississippi and the Missouri (lat. $38^{\circ} 51'$). It bears the name in those countries of the *Mountains of Ozark*†, and attains 300 toises of height. An excellent observer, Mr. Edwin James, believes that on the east of the Mississippi (lat. 44° — 46°), the Wisconsin Hills which

* In the north-east part of the ancient intendance of Mexico, between Zimapan, El Doctor and Ixmiquilpan.

† Ozark is at once the ancient name of Arkansas, and of the tribe of the Quawpaws Indians, who inhabit the banks of that great river. The culminant point of the *Mountains of Ozark* is in $37\frac{1}{2}^{\circ}$ of latitude, between the sources of the White and Osage rivers. (*Long. Expedition to the Rocky Mount.*, 1823, Vol. ii, p. 80, 409, 423.)

stretch to the N.N.E. towards Lake Superior, may probably be a continuation of the mountains of Ozark. They seem to be characterized by their metallic wealth as a prolongation of the eastern Cordillera of Mexico. The western branch, or Cordillera, occupies a part of the province of Guadalupe, and stretches by Culiacan, Arizpe, and the auriferous lands of the Pimeria Alta and la Sonora, as far as the banks of the Rio Gila (lat. 33° — 34°), one of the most ancient dwellings of the Aztec nations. We shall soon see that this western chain appears to be linked by the counter-forts that advance towards the west, with the *maritime Alps of California*. Finally, the central Cordillera of Anahuac, which is the most elevated, runs first from south-east to north-west, by Zacatecas towards Durango, and afterwards from south to north, by Chihuahua, towards New Mexico. It takes successively the names of Sierra de Acha, Sierra de Los Mimbres, Sierra Verde, and Sierra de las Grullas, and joins towards the 29° and 30° of latitude, by counter-forts, two lateral chains, those of the Texas and la Sonora, which renders the separation of the chains more imperfect than the trifurcations of the Andes in South America.

That part of the Cordilleras of Mexico which is richest in silver beds and veins, is comprehended between the parallels of Oaxaca and

Cosiquiriachi (lat. $16\frac{1}{2}^{\circ}$ — 29°) the sole lands of produce or alluvial, that contain disseminated gold, extend still some degrees more towards the north *. It is a very striking phenomenon, that the gold-washing of Cinaloa and Sonora, like that of Barbacoas and Choco, on the south and north of the isthmus of Panama, is uniformly placed on the west of the central chain, on the descent opposite the Pacific Ocean. The traces of a still burning volcanic fire, which was no longer seen, on a length of 200 leagues, from Pasto and Popayan to the gulph of Nicoya (lat. $1\frac{1}{4}^{\circ}$ — $9\frac{1}{2}^{\circ}$), become very frequent on the western coast of Guatemala (lat. $9\frac{1}{2}^{\circ}$ — 16°); these traces of fire again cease in the mountains of gneis-granite of Oaxaca, and reappear, perhaps for the last time, towards the north, in the central Cordillera of Anahuac, between the $18\frac{1}{4}^{\circ}$ and $19\frac{1}{2}^{\circ}$ of latitude, where the volcanoes of Taxtla, Orizaba, Popocatepetl, Toluca, Jorullo, and Colima, appear to be placed on a crevice †

* According to the division of the mines of Mexico in eight groupes (*See my Polit. Essay*, Vol. iii, p. 123), the mines of Cosiquiriachi, Batopilas, and Parral, belong to the groupe of Chihuahua, in the intendance of Durango or New Biscay.

† On this zone of volcanoes is the parallel of the greatest heights of New Spain. (*See Polit. Essay*, Vol. i, p. 61.) If the survey of Captain Basil Hall (*Extracts from a Journal written on the coasts of Chili, Peru, and Mexico, 1824*,

which extends from E.S.E. to W.N.W., from one ocean to another. This line of summits, of which several enter into the limit of perpetual snows, and which are the loftiest of the Cordilleras from the peak of Tolima (lat. $40^{\circ} 46'$ nor.), is almost perpendicular to the great axis of the chain of Guatemala and Anahuac, advancing to the 27th parallel, constantly N. 42° E. It is, as I have observed above, a characteristic feature of every knot, or widening of the Cordilleras, that the grouping of the summits is independent of the general direction of the axis. The back of the mountains in New Spain form very elevated plains, where carriages can roll on a length of 400 leagues, from the capital to Santa-Fe and Taos, near the sources of Rio del Norte. This immense table-land, in 19° and $24\frac{1}{2}^{\circ}$ of latitude, remains constantly at the height of 950 to 1200 toises, that is, at the elevation of the passages of the Great Saint Bernard and Splugen. We find on the back of the Cordilleras of Anahuac, which lower progressively from the town of Mexico towards Taos (northern limit of the *Provincias internas*),

Vol. ii, p. 379), yields results alike certain in latitude as in longitude, the volcano of Colima is on the north of the parallel of Puerto de Navidad, in $19^{\circ} 36'$ of latitude, and, like the volcano of Tuxtla, if not beyond the zone, at least beyond the *mean parallel* of the volcanic fire of Mexico, a parallel which appears to fall between $18^{\circ} 59'$, and $19^{\circ} 12'$.

a succession of basins: they are separated by hills little striking to the eye of the traveller because they rise but 250 to 400 toises above the surrounding plains. These basins are sometimes closed, like the valley of Tenochtitlan, where lie the great Alpine lakes, and sometimes present traces of ancient ejections, destitute of water.

Between lat. 33° and 38° , the Rio del Norte forms, in its upper course, a great longitudinal valley; and the central chain seems here to be divided into several parallel ranges. This disposition continues, towards the north, in the *Rocky Mountains**, where, according to the intrepid labors of Captain Pike, Major Long, and Dr. Edwin James, between the parallels of 37° and 41° , several summits covered with eternal snows (Spanish Peak, James Peak, and Big-horn)†, are from 1600 to 1870 toises of abso-

* The *Rocky Mountains* have been known at different periods by the names of *Chypewyan*, *Missouri*, *Columbian*, *Caous*, *Stony*, *Shining* and *Sandy Mountains*. (See Long. *Exped.* Vol. ii, p. 405; and Humb. *Per. Nar.* Vol. iv, p. 9.)

† These peaks of amphibolic granite, do not form three insulated mountains; each peak has several pointed summits. *Spanish Peak*, (lat. $37^{\circ} 20'$ long. $106^{\circ} 55'$) is placed between the source of the northern branch (*Northern Fork*) of Canadian River, and the source of the Arkansas; it is perhaps the Sierra de Taos of the ancient Mexican maps, N.N.E. of Taos, (the Tous of Mellish, and of so many maps

lute height. Towards 40° of latitude, on the south of the sources of Padouca, a tributary

published in the United States). *Spanish Peak* is succeeded towards the north, by *James Peak* ($38^{\circ} 38'$ lat. $107^{\circ} 52'$ long.) between the sources of the Arkansas and the Padouca, a tributary of the River Platte (*Ne-brasca*), that is, *shallow water*, in the language of the Otoes Indians, and not as marked on a new French map, Rio de la Plata, *rivière d'argent* !) Finally, in lat. $40^{\circ} 3'$, long. $108^{\circ} 30'$, between the two branches of the River Platte, rises the Bighorn, or Highest Peak, of Captain Pike, perhaps the Sierra Almagre of the inhabitants of New Mexico. The central mountain of these three great masses, James Peak, is estimated at 11,500 English feet (1798 toises) of absolute height; but this height trigonometrically measured, is only 8507 English feet (1330 toises): the height of the base above the level of the sea (468 toises) is not founded on a barometric measurement, but on the estimates, somewhat vague, of the descent of the three rivers Platte, Missouri, and Mississippi (*Long. Exped.* Vol. ii, p. 32, 382. *Ap.* p. xxxviii). Captain Pike, from analogous hypotheses, but which are certainly not so good as those of Major Long and Mr. James, assigned 1250 toises of elevation to this table-land, or these plains at the back of the Rocky Mountains. Mr. James computes in two cuts, the loftiest summits of the Rocky Mountains to be, in 35° latitude, 10,500 English feet (1642 toises); and in 41° , nearly 12,000 English feet (1876 toises). The lower limit of the perpetual snows appeared to him in $38\frac{1}{2}^{\circ}$ latitude, to be 1530 toises, a height which, in the system of European climates, corresponds to 40° of latitude. The astronomical positions assigned by Major Long, to the eastern declivity of the Rocky Mountains ($107^{\circ} 20'$ west of Paris, in 38° of latitude) appear to merit great confidence, the Peaks being

stream of the river Platte, a branch known by the name of the *Cotes Noires* * separates towards the north-east from the central chain. The Rocky Mountains seem at first to lower considerably in 46° and 48° ; and then rise to 48° and 49° , where their tops are 1200 to 1300 toises, and their ridge near 950 toises. Between the sources of the Missouri and the river Lewis, one of the tributary streams of the Oregon or Columbia, the Cordilleras form in widening, an elbow resembling the knot of Cuzco†. There also, on the eastern declivity of the Rocky Mountains, is the partition of water between the Caribbean Sea and the Polar Sea. This point corresponds with those which we have noted above, in the Andes of South America, on the counter-fort of Cochabamba, on the east, lat. $19^{\circ} 20'$ south; and in the Alto de los Ro-

linked by chronometric lines, and some observations of the satellites of Jupiter, at the Mississippi; but it must not be forgotten, that the place of those peaks relatively to Taos and Santa Fe of New Mexico, is much more uncertain. Lafora and Rivera differ $18'$ in the lat. of Santa Fe, and the combinations from which I was able to deduce the difference of the meridians of Santa Fe and Mexico, are far from being satisfactory. (*See my Pol. Essay*, Vol. i, p. lxi.) I expect with impatience the observations made on the west of the peaks.

* *Black Hills*, which are 260 toises high; they stretch towards the parallel of 46° .

† See above, Vol. vi, p. 426.

bles (lat. $2^{\circ} 20'$ north), on the west. The ridge that separates the Rocky Mountains stretches from west to east, towards Lake Superior, between the basins of the Missouri, and that of the Lake Winnipeg and the Slave Lake. We have seen the central Cordillera of Mexico and the Rocky Mountains follow the direction N. 10° W., from 25° to 38° of latitude; the chain from that point to the Polar Seas is prolonged in the direction N. 24° W., and ends in the parallel 69° , at the mouth of the Mackenzie river*.

In thus developing the structure of the Cordilleras of the Andes from 56° south, to beyond the arctic circle, we have seen that its northern extremity (long. $130^{\circ} 30'$), is nearly 61° of longitude west of its southern extremity (long. $69^{\circ} 40'$); this is the effect of the long duration of a direction from S.E. to N.W. on the north of the isthmus of Panama. By the extraordinary breadth of the New Continent, in the 30° and 60° of north latitude, the Cordillera of the Andes, continually drawing nearer the western coast in the southern hemisphere, is

* The eastern boundary of the *Rocky Mountains* lies—

In 38° latitude $107^{\circ} 20'$ longitude.

40° $108^{\circ} 30'$

63° $124^{\circ} 40'$

68° $130^{\circ} 30'$

removed 400 leagues on the north from the source of the River de la Paix. The Andes of Chili may be considered as the maritime Alps*, while, in their most northern continuation, the Rocky Mountains are a chain of the interior of a continent. There exists no doubt, between 23° and 60° of latitude, from the Cape Saint Lucas in California to Alaska, on the western coast of the Sea of Kamtschatka, a real Cordillera of the shore; but it forms, as we observed above †, a system of mountains almost entirely distinct from the Andes of Mexico and Canada. This system, which we shall call the *Cordillera of California, or of New Albion*, is linked between lat. 33° and 34° with the Pimeria alta, and the western branch of the Cordilleras of Anahuac; and between 45° and 53° of latitude, with the Rocky Mountains, by transversal ridges and counter-forts that widen towards the east. We shall learn from well-informed travellers who may one day pass over the unknown land between Cape Mendocino and the source of the Rio Colorado, if the connexion of the maritime Alps of California or New Albion, with

* A chain of the shore, geognostically speaking, is not a range of mountains that forms of itself the coast; this name is extended to a chain separated from the coast by a narrow plain.

† Vol. vi, p. 410, &c.

the western branch of the Cordilleras of Mexico, resembles that, which, notwithstanding the depression, or rather total interruption observed on the west of Rio Atrato, is admitted by geographers, between the mountains of the isthmus of Panama, and the western branch of the Andes of New Grenada. The maritime Alps, little elevated in the peninsula of Old California, rise progressively towards the north in the Sierra of Santa Lucia (lat. $34\frac{1}{2}^{\circ}$), in the Sierra of San Marcos (lat. 37° — 38°) and in the snowy mountains near Cape Mendocino (lat. 39° — 41°); the last seem to attain at least the height of 1500 toises. From Cape Mendocino, the chain follows the coast of the Pacific Ocean, but at the distance of from 20 to 25 leagues. Between the lofty summits of Mount Hood and Mount Saint Helen, in $45\frac{3}{4}^{\circ}$ latitude, it is broken by the great Rio Columbia. In New Hanover, New Cornwall, and New Norfolk *, these rents of a rocky coast are repeated, these geognostic phenomena of *fjords* that characterize western Patagonia, and Norway. Two volcanic peaks are placed where the Cordillera turns towards the west (lat. $58\frac{3}{4}^{\circ}$, long. $139^{\circ} 40'$) †, one of which, Mount

* Harmon, Journal of Travels in the interior of North America, p. 78.

† Trigonometrical measurements made by the expedition of Malaspina, and which appear to deserve entire confidence,

Saint Elie, perhaps equals Cotopaxi in height; the other, Fair Weather Mountain, equals the height of Mount Rosa. The elevation of the former exceeds all the summits of the Cordilleras of Mexico and the Rocky Mountains, on the north of the parallel $19\frac{1}{4}^{\circ}$; it is even the culminant point in the northern hemisphere, of the whole known world north of 50° of latitude. Towards the north-west of the peaks of Saint Elie and Fair-Weather, the chain of California widens considerably * in the interior of Russian America. The volcanoes multiply in number as we advance towards the west, in the peninsula of Alasca, and the Isles des Renards, where the volcano Ajagedan rises to the height † of 1175 toises above the level of the Ocean. It is thus that the chain of the maritime Alps of California, appears to be undermined by sub-

place Mount Saint Elie (lat. $60^{\circ} 17' 35''$), and not, like Laperouse, at 1980 toises, but at 2793 toises; and Mount Fair-Weather, *Montana de Buentiempo*, in lat. $59^{\circ} 0' 42''$, at 2304 toises. (See *Relacion del Viage al Estrecho de Fuca*, 1802, p. cxv and cxc. The little care bestowed on the publication of the voyage of Laperouse having caused many errors, which have been falsely attributed to that illustrious and unfortunate navigator (*Krusenstern, Reise um des Welt.*, Tom. ii, p. 15), it would be important to verify the measure of Mount Saint Elie on the manuscript of the journals brought back to France.

* See my *Pol. Essay on New Spain*, Vol. ii, p. 331.

† According to the measure of M. de Kotzebue.

terraneous fires, at its two extremities; towards the north, in 60° of latitude, and towards the south in 28° in the volcano of the Virgins*. If it were certain that the mountains of California belong to the western branch of the Andes of Anahuac, it might be said that the volcanic fire, still burning, abandons the central Cordillera when it removes from the coast, that is from the volcano of Colima; and that the fire is borne on the north-west by the peninsula of Old California, Mount Saint Elie, and the peninsula of Alaska, towards the Aleutes Islands, and Kamtschatka.

I shall terminate this sketch of the structure of the Andes, by recapitulating the principal features that characterize the Cordilleras on the north-west of Darien.

Lat. 8° - 11° . Mountains of the isthmus of Panama, Veragua, and Costa Rica, slightly linked to the western chain of New Grenada, which is that of Choco.

Lat. 11° - 16° . Mountains of Nicaragua and Guatimala; line of volcanoes N. 50° W., for the most part still burning, from the gulph of Nicoya to the volcano of Soconusco.

* Volcanes de las Virgenes. The highest summit of Old California, the Cerro de la Giganta (700 toises), appears to be also an extinguished volcano. (*Manuscript of Colonel Costanzo.*)

Lat. 16° 18° . Mountains of gneiss-granite in the province of Oaxaca.

Lat. $18\frac{1}{2}^{\circ}$ $19\frac{1}{2}^{\circ}$. Trachytic knot of Anahuac, parallel to the Nevados and the burning volcanoes of Mexico.

Lat. $19\frac{1}{2}^{\circ}$ 20° . Knot of metaliferous mountains of Guanaxuato and Zacatecas.

Lat. $21\frac{1}{4}$ $22'$. Division of the Andes of Anahuac into three chains :

Eastern chain (of Potosi and Texas), continued by the mountains Ozark and Wisconsin, as far as Lake Superior.

Central chain (of Durango, New Mexico, and the Rocky Mountains,) sending, on the north of the source of the river Platte (lat. 42°), a branch (the Cotes Noires) towards the N. E., widening greatly between the parallels 46° and 50° , and lowering progressively as it draws near the mouth of Mackenzie river (lat. 68°).

Western chain (of Cinaloa and Sonora). It is linked by counter-forts to the maritime Alps, or mountains of California.

We have yet no means of judging with precision the elevation of the Andes on the south of the knot of the mountains of Loxa (south lat. 3° - 5°) ; but we know that on the north of that knot, the Cordilleras rise five times above the majestic height of 2600 toises :

In the groupe of Quito, 0° to 2° south lat. (Chimborazo, Antisana, Cayambe, Coto-paxi, Collanes, Yliniza, Sangai, Tunguragua.)

In the groupe of Cundinamarca, lat. $4\frac{1}{2}^{\circ}$ north (peak of Tolima, on the north of the Andes of Quindiu).

In the groupe of Anahuac, from lat. $18^{\circ} 59'$ to $19^{\circ} 12'$ (Popocatepetl or Great Volcano of Mexico and Peak of Orizaba). If we consider the maritime Alps or mountains of California and New Norfolk, either as a continuation of the western chain of Mexico, that of Sonora, or, as being linked by counterforts to the central chain, that of the Rocky Mountains, we may add to the three preceding groupes :

The groupe of Russian America, from lat. 60° to 70° (Mont Saint Elie). On an extent of 63° latitude, I know only twelve summits of the Andes that reach the height of 2600 toises, and consequently surpass 140 toises the height of Mont Blanc. Three only of the twelve summits are placed on the north of the isthmus of Panama.

β. INSULATED GROUPE OF THE SNOWY MOUNTAINS OF SANTA MARTA. In the enumeration of the different systems of mountains, I place this groupe before the chain of the shore of Vene-

zuela, although the latter, being a northern prolongation of the Cordillera of Cundinamarca, is immediately linked with the chain of the Andes. The *Sierra Nevada of Santa Marta* is contained within two divergent branches of the Andes, that of Bogota, and that of the isthmus of Panama. It rises abruptly like a fortified castle, amidst the plains extending from the gulph of Darien, by the mouth of the Magdalena, to the lake of Maracaybo. I have stated above* the ancient error of geographers, who have considered this insulated groupe of mountains covered with eternal snows, as the extremity of the high Cordilleras of Chita and Pamplona. The loftiest ridge of the Sierra Nevada de Santa Marta is only three or four leagues in length in the direction from east to west; it is bounded (at nine leagues distance from the coast,) by the meridians of the capes of San Diego and San Augustin. The culminant points, called El Picacho and Horqueta†, are placed near the western border of the groupe; they are entirely separated from the peak of San Lorenzo, alike

* Vol. vi, p. 396.

† According to the observations of M. Fidalgo (*Tierra firme, hoja tercera, Madrid, 1817*), the Horqueta is situated lat. $10^{\circ} 51'$, and long. $67^{\circ} 29'$ Cad., in supposing S. Marta 68° long. Cad.; it thence results, if with M. Oltmans, we adopt $76^{\circ} 29'$ Par. for the latter port, $75^{\circ} 58'$ Par. for the Horqueta.

covered with eternal snows, but only four leagues distant from the port of Santa Marta towards the S. E. I saw this latter peak from the heights that surrounded the village of Turbaco *, south of Carthagena. No precise measurement has hitherto ascertained the height of the Sierra Nevada, which Dampierre affirms to be one of the highest mountains of the northern hemisphere. Combinations founded on the *maximum* of distance at which the groupe is discovered at sea, yield more than 3004 toises of height †. This measure, notwithstanding the uncertainty of terrestrial refraction, would be less deficient if it had been made in the meridian of Horqueta, and if the errors of ship longitude did not render the distance to the snowy summits uncertain. The direct proof that the groupe of the mountains of Santa Marta are *insulated*, is found in the ardent climate of the lands (*tierras calientes*) that sur-

* Peak of San Lorenzo, according to Fidalgo, lat $11^{\circ} 6' 45''$, long. $67^{\circ} 50'$ Cad. Turbaco, according to my observations, lat. $10^{\circ} 18' 5''$, long. $77^{\circ} 41' 51''$ Par. (The meridians of Cadiz and Paris differ $8^{\circ} 37' 37''$.)

† Pombo, *Noticias varias sobre las Quinas*, 1824, p. 67 and 139. In this work, filled with useful knowledge, the latitude of the Peak of San Lorenzo is indicated at $10^{\circ} 7' 15''$, instead of $11^{\circ} 7' 15''$, an error so much the more dangerous, as the Horqueta is there called *la Sierra mas avanzada al mar*.

round them, on the east, towards the Rio Palomino; on the south, towards the villages of Valencia de Jesus and Santa Maria Ansola, towards the sources of the Rio Cesar, and towards the *Valle de Upar*, anciently known by the name of the Villa de Reyes; and on the west, towards the Aracataca *. Low ridges and a succession of hills indicate perhaps an ancient connection of the Sierra Nevada of Santa Marta on one side, by the *Alto de las Minas* † (on the west of Laguna Zapatosa) with the phonolitic and granitic rocks of Peñon and Banca ‡, and on the other, by the Sierra de Perija with the mountains of Chiliguaná and Ocaña, which are the counter-forts § of the eastern chain of the Andes of New Grenada. In this latter chain the febrifuge species of quinquina (*corollis hirsutis, staminibus inclusis*) which advance most to the N. E., are those of the Sierra Nevada de Merida ||; but the real Cinchona, the most northern of South America, is found in the temperate region of the Sierra Nevada of Santa Marta.

* MSS. of General Cortes.

† It is a prolongation of the *Sierra Nevada* towards the S. W.

‡ On the banks of the Rio Magdalena, a little to the northward of Tamalameque and Regidor, of which I found the lat. $8^{\circ} 30'$, and the long. $76^{\circ} 13'$.

§ Vol. vi, p. 453.

|| Vol. vi, p. 210.

γ. CHAIN OF THE SHORE OF VENEZUELA. This is the system of mountains of which the configuration and direction have excited so powerful an influence on the state of cultivation and commerce of the ancient *Capitania general* of Venezuela. It bears different names (mountains of Coro, of Caraccas, of Bergantin, of Barcelona, of Cumana, and of Paria); but all these names belong to the same chain, of which the northern part runs constantly along the coast of the Caribbean Sea. It would be superfluous to repeat here that this system of mountains, which is 160 leagues long*, is a prolongation of the eastern Cordillera of the Andes of Cundinamarca. There is an immediate connection of the chain of the shore with the Andes, like that of the Pyrenees with the mountains of Asturia and Galicia; it is not the effect of transversal ridges, like the connection of the Pyrenees with the Swiss Alps, by the Black Mountain and the Cevennes. The points of junction, hitherto so ill indicated by the maps, are found between Truxillo, and the lake of Valencia. The following are the details of that junction.

We have observed above that this eastern chain of New Grenada stretches on the N. E. by the

* It is more than double the length of the Pyrenees from Cape Creuz to the point of Figuera.

Sierra Nevada de Merida, as well as by the four Paramos of Timotes, Niquitao, Bocono, and las Rosas, of which the absolute height cannot be less than from 1400 to 1600 toises. After the Paramo of las Rosas, which is more elevated than the two preceding, there is a great depression, and we no longer see a distinct chain or ridge, but a hilly ground*, and high table-lands surrounding the towns of Tocuyo and Barquisimeto. We are ignorant of the height even of Cerro del Altar, between Tocuyo and Caranacatu; but we know by the recent measures of MM. Rivero and Boussingault, that the most inhabited spots are from 300 to 350 toises above the level of the Ocean. The limits of the mountainous land between Tocuyo and the vallies of Aragua are, the plains of San Carlos on the south, and the Rio Tocuyo on the north; the Rio Siquisique throws itself into that river. From the Cerro del Altar on the N. E. towards Guigue and Valencia, succeed, as culminant points†, the mountains of Santa Maria (between Buria and Nirgua); then the Picacho de Nirgua, supposed to be 600 toises high; and finally Las Palomeras and El Torito (between Valencia and Nirgua). The line of partition of water runs from west to east, from

* See above, Vol. iv, p. 248; vi, p. 209.

† MS. of General Cortes.

Quibor to the lofty savannahs of London, near Santa Rosa. The waters flow on the north, towards the *Golfo triste* of the Caribbean Sea ; and on the south, towards the basins of the Apure and the Oroonoko. The whole of this mountainous country which we have just made known, and by which the chain of the shore of Caraccas is linked to the Cordilleras of Cundinamarca, enjoyed some celebrity in Europe *, in the middle of the nineteenth century ; for that part of this territory, formed of gneiss-granite, and lying between the Rio Tocuyo and the Rio Yaracui, furnishes auriferous veins of Buria, and the copper-mine of Aroa, which is still worked in our days. If, across *the knot of the mountains of Barquisimeto*, we trace the meridians of Aroa, Nirgua, and San Carlos, which are so near each other, we observe that the N. W. of that *knot* is linked with the Sierra de Coro, called also Sierra de Santa Lucia, and on the N. E. with the mountains of Capadare, Porto Cabello, and the Villa de Cura. It may be said to form the eastern wall of that vast circular depression of which the lake Maracaybo is the center, and which is bounded on the south and west, by the mountains of Merida, Ocaña, Perija, and Santa Marta.

The chain of the shore of Venezuela, of which

* Vol. iii, p. 528.

the existence was recognized by Pierre Martyr d'Anghiera *, presents towards the center, and the east, the same phenomena of structure which we have remarked in the Andes of Peru and New Grenada; namely, the division into several parallel ranks, and the frequency of longitudinal basins or vallies. But the irruptions of the Caribbean Sea having it appears overwhelmed very anciently a part of the mountains of the shore, the ranks, or partial chains are interrupted, and some basins are become oceanic gulphs. To comprehend the Cordillera of Venezuela in mass, we must carefully study the direction and windings of the coast from Punta Tucacas (west of Porto Cabello), as far as Punta de la Galera of the island of Trinidad. That island, those of los Testigos, la Marguerita, and Tortuga, constitute, with the micaslates of the peninsula of Araya, the same system of mountains. The granitic rocks which shew themselves between Buria, Duaca, and Aroa †, cross the valley of the Rio Yaracui, and draw near the shore, whence they stretch, like a continued wall, from Porto Cabello to Cape Codera. This prolongation forms the *northern chain* of the Cordillera of Venezuela, and is traversed in going

* *Oceanica* (ed. 1531) Dec. 3, lib. iv, p. 52.

† On the east of San Felipe, in the *knot of the mountains* of Tocuye and Barquisimeto.

from south to north, either from Valencia and the vallies of Aragua, to Burburata and Turiamo, or from Caraccas to La Guayra. The hot sources * issue from those flanks, those of Las

* See above, Vol. iii, p. 199 ; Vol. iv, p. 52, 167, 196, and 271. The other hot sources of the Cordillera of the shore, are those of S. Juan, Provisor, Brigantin, the gulph of Cariaco, Cumacatar, and Irapa. MM. Rivero and Bous-singault, who visited the thermal waters of Mariara, in February, 1823, during their journey from Caraccas to Santa Fe de Bogota, found their *maximum* to be 64° cent. I found it at the same season, only 59·2°. Has the great earthquake of the 26th of March, 1812, had an influence on the temperature of these sources ? The able chemists whom I have just mentioned, were struck like myself, with the great purity of the hot waters that issue from the primitive rocks of the basin of Aragua. "Those of Onoto, which flow at the height of 360 toises above the level of the sea, have no smell of sulphurated hydrogen ; they are without taste, and cannot be precipitated, either by nitrate of silver or any reactive. When evaporated, they have an inappreciable residue, which consists of a little silica and a trace of alcali ; their temperature is only 44·5°, and the bubbles of air which are disengaged intermittingly, are at Onoto, as well as in the thermal waters of Mariara, of *pure gaz azote* (See above, Vol. vi, p. 80). The waters of Mariara (244 toises) have a faint smell of sulphurated hydrogen ; they leave by evaporation a slight residuum, that yields carbonic acid, sulphuric acid, soda, magnesia, and lime. The quantities are so small that the water is altogether without taste." (Letter of M. Boussingault to M. de Humboldt, in the *Annales de Phys. et de Chimie*, tom. xxvi, p. 81.) During my journeys I found the source of the Comangillas only, (near Guanaxuato in

Trincheras ($90^{\circ}4'$) on its southern slope, and those of Onoto and Mariara on its southern slope. The former issue from a granite with large grains, very regularly stratified; the latter from a rock of gneiss. What especially characterizes the *northern chain*, is a summit which is not only the loftiest of the system of the mountains of Venezuela, but of all South America, on the east of the Andes. The eastern summit of the Silla of Caraccas, according to my barometric measurement, made in 1800, is 1350 toises high *. MM. Boussingault and Rivero carried an excellent barometer of Fortin, in 1822, on this very summit, which they found to be from $1351\frac{1}{2}$ toises; this proves that notwithstanding the commotion which took place on the Silla during the great earthquake

Mexico,) still hotter than the thermal waters of las Trincheras, situated on the south of Porto Cabello. The waters of Comangillas flow at 1040 toises high, and are alike remarkable for their purity, and their temperature of $96^{\circ}3'$ cent.

* Vol. iii, p. 505; Vol. iv, p. 21. The Silla of Caraccas is only 80 toises lower than the Canigou in the Pyrenees. As Caraccas, Santa Fe de Bogota, and Quito, may be considered as the three capitals of Columbia, I shall here repeat, in order to establish a precise comparison of the height of those three towns, that the inhabitants of Caraccas recognize at once in the summit of the Silla which commands their town, the level of the plains of Bogota, and a point of 150 toises, which is less elevated than the great square of Quito.

of Caraccas, that mountain did not sink 50 or 60 toises, as several North American journals asserted. Four or five leagues south of the *northern chain*, which is that of Mariara, la Silla, and Cape Codera, the mountains of Guiripa, Ocumare, and Panaquire, form the *southern chain* * of the coast, which stretches in a parallel direction from Guigue to the mouth of the Rio Tuy, by the Guesta of Yusma, and the Guacimo. The latitudes of the Villa de Cura and San Juan, so erroneously placed on our maps, enabled me to ascertain the mean breadth of the whole Cordillera of Venezuela. Ten or twelve leagues † may be counted from the descent of the northern chain which bounds the Caribbean Sea, to the descent of the southern chain which bounds the immense basin of the Llanos. This latter chain, designated also by the name of the *Inland Mountains*, is much lower than the northern chain; and I scarcely believe that the Sierra de Guayraima attains the height of 1200 toises, although this has been recently affirmed.

The two partial chains, that of the interior, and that which lies along the coast, are linked

* Vol. iv, p. 107, 269, 273.

† The breadth is very considerable towards the east, regarding the Cerro de Flores (lat. $9^{\circ} 28'$) south-west of Parapara and Ortis, as placed on the limit of the Llanos de Calabozo.

by a ridge or knot of mountains * known by the names of Altos de las Cocuyzas (845 t.) and the Higuerote (835 t.) between Los Teques and La Victoria, in $69^{\circ} 30'$ and $69^{\circ} 50'$ of longitude. On the west of this ridge lies the basin, entirely inclosed †, of the lake of Valencia or the *Valles de Aragua*; and on the east, the basin of the Carracas and of the Rio Tuy. The bottom of the former of these basins is from 220 to 250 toises high; the bottom of the latter is 460 toises above the waters of the Caribbean Sea. It results from these measures, that the most western of the two longitudinal vallies of the Cordillera

* Vol. iv, p. 77, 80.

† This basin contains a *small system of inland rivers*, which do not communicate with the Ocean. The southern chain of the Cordillera of the shore of Venezuela is so depressed towards the south-west, that the Rio Pao is separated from the tributary streams of the lake of Tacarigua or Valencia (Vol. iv, 149 and 154). Towards the east, the Rio Tuy, which takes its rise on the western declivity of the knot of mountains of Las Cocuyzas, appears at first to throw itself into the vallies of Aragua; but hills of calcareous tuf, forming a ridge between Consejo and Victoria (Vol. iv, p. 80), force it to take its course south-east. In order to rectify what is said above (Vol. iv, p. 162, note *) on the composition of the waters of the lake of Valencia, I shall here mention that MM. Boussingault and Rivero found no traces in them of nitre or potash, but $\frac{1}{2000}$ of carbonat of soda and of magnesia, muriate of soda and sulfate and carbonate of lime.

of the shore is the deepest ; while in the plains near the Apure and the Oroonoko, the declivity is from west to east ; but we must not forget that the peculiar disposition of the bottom of the two basins, which are bounded by two parallel chains, is a local phenomenon altogether separate from the causes on which the general structure of the country depends. The eastern basin of the Cordillera of Venezuela is not shut up like the basin of Valencia. It is in the knot of the mountains of Las Cocuyzas, and of Higuerote, that the Serrania de los Teques and Oripoto, stretching towards the east, form two vallies, those of the Rio Guayre and Rio Tuy ; the former contains the town of Caraccas, and both unite below the Caurimare. The Rio Tuy runs through the rest of the basin, from west to east, as far as its mouth, which is situated on the north of the mountains of Panaquire.

The northern range of the mountains of the shore of Venezuela seems to terminate at Cape Codera ; but this is only an apparent interruption *. The coast forms a vast nook, thirty-five marine leagues in length, at the bottom of which is the mouth of the Rio Unare, and the road of Nueva Barcelona. Stretching first from west to east, in the parallel of $10^{\circ} 37'$, this coast draws in at the parallel $10^{\circ} 6'$, and re-

* Vol. ii, p. 262.

sumes its ancient direction ($10^{\circ} 37'$ — $10^{\circ} 44'$) from the western extremity of the peninsula of Araya, to the eastern extremity of Montaña de Paria and the island of Trinidad. It results from this position of the coast, that the range of mountains near the shore of the provinces of Caraccas and Barcelona, between the meridian $66^{\circ} 32'$ and $68^{\circ} 29'$, and which I saw on the south of the bay of Higuerote; and on the north of the Llanos * of Pao and Cachipo, must be considered as the continuation of the *southern chain of Venezuela*, and as being linked towards the west with the Sierras de Panaquire and Ocumare. The chain of the interior consequently, between Cape Codera and Cariaco, forms itself the coast. This range of very low mountains, often interrupted from the mouth of the Rio Tuy to that of the Rio Neveri, rises abruptly on the east of Nueva Barcelona, first in the rocky island of Chimanas †, and then in the *Cerro del Bergantin*, elevated probably more than 800 toises, but of which the astronomical position and the precise height are yet alike unknown ‡. The northern chain (that of

* Vol. iii, p. 375, 376; Vol. vi, p. 53 and 68.

† Vol. iii, p. 357; Vol. vi, p. 85.

‡ Vol. ii, p. 206; Vol. iii, p. 94. The peak of Cumanacoa, which the five maps of the *Deposito hydrografico* of Madrid place lat. $10^{\circ} 7'$, is perhaps the Turimiquiri; for

Cape Codera and the Silla of Caraccas) reappears on the meridian of Cumana. The micaceous-slate of the peninsula of Araya and Maniquarez* are joined by the ridge or *knot of mountains of Meapire* †, to the southern chain, that of Panagui, Bergantin, Turimiquiri, Caripe, and Guacharo ‡. I have mentioned in another place, that this ridge, not more than 200 toises of absolute height, has, in the ancient revolutions of our planet, prevented the irruption of the Ocean, and the union of the gulphs of Paria and Cariaco. On the west of Cape Codera, the northern chain, composed of primitive granitic rocks, displays the loftiest summits of the whole Cordillera of Venezuela; but the culminant points on the east of that Cape, are composed in the southern chain, of secondary calcareous rocks. We have seen above, that the peak of Turimiquiri, at the back of the Cocollar §, is 1050 toises, while the bottom of the high valleys of the convent of Caripe ||, and of Guardia de San Augustin, are 412 and 533 toises of absolute height. On the east of the ridge of Mea-

the town of Cumanacoa, according to my observations, is 10° 16' 11".

* Vol. ii, p. 362; Vol. vi, p. 92, &c.

† Vol. ii, p. 260; Vol. iii, p. 183.

‡ Vol. iii, p. 174.

§ Vol. iii, p. 94.

|| Vol. iii, p. 115.

pire, the southern chain sinks abruptly towards the Rio Arco and the Guarapiche; but, in quitting the main land, we see it again rise on the southern coast of the island of Trinidad, which is but a detached portion of the continent, and of which the northern side indubitably displays the vestiges of the northern chain of Venezuela, that is of the Montana de Paria (the Paradise of Christopher Columbus), the peninsula of Araya, and the Silla of Caraccas. The observations of latitude I made at the Villa de Cura ($10^{\circ} 2' 47''$), the farm of Cocollar ($10^{\circ} 9' 37''$), and the convent of Caripe ($10^{\circ} 10' 14''$), compared with the position more anciently known of the southern coast of Trinidad (lat. $10^{\circ} 6'$) prove, that the southern chain, south of the basins of Valencia and of Tuy* and of the gulphs of Cariaco and Paria, is still more constant in the direction from west to east than the northern chain from Porto Cabello to Punta Galera. It is highly important to know the southern limit of the *Cordillera of the shore of Venezuela*, because it determines the parallel at which the *Llanos* or

* The bottom of the first of these four basins bounded by parallel chains, is from 230 to 460 toises above, and that of the two latter from 30 to 40 toises below the present level of the sea. Hot waters gush from the bottom of the gulph of the basin of Cariaco (Vol. iii, p. 199), as from the bottom of the basin of Valencia on the continent (Vol. iv, p. 167).

the savannahs of Caraccas, Barcelona, and Cumana begin. Geographers, who are fond of copying, and of stereotyping, for ages, the chains of mountains and the branches of rivers which the caprice of the draftsman has traced on some well-known maps, never cease to figure, between the meridians of Caraccas and Cumana, two Cordilleras stretching from north to south, as far as $8\frac{1}{2}^{\circ}$ of latitude; to which they give the names of Cerros de Alta Gracia, and del Bergantin*; thus rendering a territory of

* See all the French, English, and German maps published before the *Map of Columbia*, by M. Brué (1823), for which a part of the materials were employed which I had collected on the extent and direction of the chains of mountains. The source of the error which we find in Nicolsio, Sanson (1669), and De l'Isle (1700), must be attributed to the practice of the first geographers of America, of enlarging beyond measure, the breadth of the Andes of Peru and New Grenada, and placing them so far towards the east, that Quito is sometimes found on the meridian of Cumana (Vol. v, p: 853). In this manner, the steppes of Venezuela were covered with mountains that linked the *groupe of the Parime* with the chains of the shore of Caraccas. De l'Isle places the *Valley of Sayma* near the range of mountains which Sanson had marked as going from *north to south*, from Barcelona to the Oroonoko; this proves that he had some confused idea of the mountains of Caripe, inhabited by the Chaymas Indians. D'Anville, according to systematic ideas on the origin of rivers, figures a ridge between the sources of the Unare, the Guarapiche, the Pao, and the Manapire (Vol. iv, p. 301). This is the pattern

25 leagues broad, mountainous, where we should seek in vain a mound of a few feet in height.

In fixing our eyes on the Island of Marguerita, composed, like the peninsula of Araya, of micaceous slate, and anciently linked with that peninsula by the Morro de Chacopata and the isles of Coche and Cubagua*, we are inclined to recognize in the two mountainous groupings of Macanao and la Vega de San Juan, the traces of a third chain of the Cordillera of the shore of Venezuela. Do these two groupings of Marguerita, of which the most westerly is above 600 toises high †, belong to a sub-marine chain stretching by the isle of Tortuga, towards the Sierra de Santa Lucia de Coro, on the parallel of 11° ? Must we admit, that in $11\frac{1}{4}^{\circ}$ and $12\frac{1}{2}^{\circ}$ of latitude, a fourth chain, the most northerly of all, stretched heretofore by the island of Hermanos, by Blanquilla, the Orchila, Los Roques, Aves, Buen Ayre, Curacao, and Oruba, towards Cape Chichivacoa? These important problems can only be solved when this chain of islands parallel to the coast have been examined by a well-informed geognost. It must not be for-

which has been hitherto followed, and from which Surville himself has not ventured to deviate in his map subjoined to Caulin's work.

* See Vol. vi, p. 94.

† Vol. ii, p. 46.

gotten, that one great irruption of the Ocean appears to have taken place between Trinidad and Grenada*, and that no where else in the long series of the Little Antilles, two neighbouring islands are so far removed from each other. We recognize the effect of the *current of rotation* in the direction of the coast of Trinidad, as in the coasts of the provinces of Cumana and Caraccas, between Cape Paria and Punta Araya, and between Cape Codera and Porto Cabello †. If a part of the continent has been overwhelmed by the Ocean on the north of the peninsula of Araya, it is probable, that the enormous sand-bank which surrounds Cubagua, Coche, the island of Marguerita, Los Frailes, la Sola, and the Testigos, marks the extent and outline of the submerged land. This sand-bank or *placer* of 200 square leagues, is only well

* It is affirmed that the island of Trinidad is traversed in the northern part by a chain of primitive slate, and that Grenada furnishes basalts. It would be important to examine of what rock the island of Tobago is composed; it appeared to me of a dazzling whiteness (Vol. ii, p. 27; Vol. iv, p. 45); and on what point, in going from Trinidad towards the north, the trachytic and trapean system of the Little Antilles begins.

† The same effects of the current of rotation, and the same regular direction E. and W., may be remarked opposite the coast of the main-land, on the shore of Portorico, of Haiti or Saint-Domingo and the island of Cuba, between the Punta Maysi and Cabo Crux.

known in all its extent, by the tribe of the Guayqueries; it is frequented by these Indians on account of its abundant fishery in calm weather. The *Gran Placer* is believed to be separated only by some canals or deeper furrows of the bank of Grenada, which have almost the same form as the island of that name, from the sand-bank that extends like a narrow dyke, from Tobago to Grenada, and which is recognized by the lowering of the temperature of the water*; finally, from the sand-banks of Los Roques and Aves. I know that able navigators deny these communications, because they consider the bottom of the sea in a different point of view from the geologist. Marine maps appropriated to the wants of navigation, indicate no banks where there are 50 or 60 toises of water; but what is so slight a depression in the eyes of one who seeks to study the inequalities of the surface of the globe, in mass, below, and above the level of the sea? The Guayqueries Indians, and the inhabitants in general of the coast of Cumana and Barcelona, are imbued with the idea that the water of the sand-banks of Marguerita and the Testigos diminishes from year to year; they believe that in the lapse of ages, the Morro de Chacopata on the peninsula of Araya, will be joined by a neck

* Vol. ii, p. 28.

of land, to the isles of Lobos and Coche. The partial retreat of the waters on the coast of Cumana * is incontestable, and the bottom of the sea has been raised † at several epochs, by the effect of earthquakes; but these local phenomena, already so difficult to explain by the action of volcanic force, the changes in the direction of currents, and the swelling of the waters which are the necessary consequences, are still far removed from the effects which are manifested at once on several hundred square leagues.

§. GROUP OF THE MOUNTAINS OF PARIME. It is essential to mineralogical geography to designate by one name the whole of the mountains that form one system. In order to attain this end, a denomination which belongs only to a partial groupe, might be extended over the whole chain; or a name employed, not susceptible by its novelty of giving rise to homogenic mistakes. We know how confused the orography of the interior of Asia has remained, from the obstinacy with which the vague names of Mustang, properly called Mussur, have so long been preserved. The mountaineers designate every

* Vol. iii, p. 184.

† Vol. ii, p. 220. Compare also Bollingbroke, Voyage to Demerary, p. 201. Ideas of the progressive and continued heaving-up of the land prevails also in Sweden and the Molucca islands.

groupe by a peculiar denomination; and a chain is generally considered as forming a whole, only when it is discovered from afar bounding the horizon of the plains. We find the names of *snowy mountains*, repeated in every zone (Himalaya, Imaus), *white* (Alpes, Alb), *black and blue*. The greater part of the *Sierra Parime* is in some sort turned by the Oroonoko. I have, however, avoided a denomination which alludes to this circumstance, because the groupe of mountains I have to make known, extends far beyond the banks of the Oroonoko. It stretches to the south-east, towards the banks of the Rio Negro, and the Rio Branco, to the parallel of $1\frac{1}{2}^{\circ}$ of north latitude. The geographical name of the Parime*, has the advantage of recalling the fable of Dorado, and the lofty mountains† which, from the sixteenth century, were supposed to surround the lake Rupunuwini, or the *Laguna de Parime*. The missionaries of the Oroonoko still give the name of Parime to the whole of the vast mountainous country comprehended between the sources of the Erevato, the Oroonoko, the Caroni, the Rio Parime‡, (a tributary of the Rio Branco), and

* Vol. v, p. 570, 780, 790.

† Vol. v, p. 941.

‡ The Rio Parime, after having received the waters of the Uraricuera, joins the Tacutu, and forms near the fort of

the Rupunuri or Rupunuwini, a tributary of the Rio Essequibo. This country is one of the most unknown parts of South America, and is covered with thick forests and savannahs; it is inhabited by independent Indians, and crossed by rivers of dangerous navigation, on account of the frequency of the bars and cataracts.

The *system of the mountains of Parime*, separate the plains of the Lower Oroonoko from those of the Rio Negro, and the Amazon; it occupies a territory of trapezoide form, comprehended between the parallels of 3° and 8° , and the meridians of 61° and $70\frac{1}{2}^{\circ}$. I indicate here only the elements of the loftiest groupe, for we shall soon see that towards the south-east, the mountainous country, in lowering, draws near the equator, and the French and Portuguese Guyanas. The *Sierra Parime* extends most in the direction N. 85° W. and the partial chains in which it divides towards the west, generally follow the same direction. It is less a Cordillera or a continued chain in the sense given to those denominations when applied to the Andes and Caucasus, than an irregular grouping of mountains separated from each other by plains and savannahs. I visited the northern, western, and southern part of the

San Joaquim, the Rio Branco, one of the tributary streams of the Rio Negro.

Sierra Parime, which by its position, and its extent of more than 25,000 square leagues, well deserves to be withdrawn from the neglect in which it has been so long buried. It remains from the confluence of the Apure as far as the delta of the Oroonoko, constantly three or four leagues removed from the right bank of the great river; only some *arrotes*, or rocks of gneiss-granite, amphibolic-slate, and greenstone advance as far as the bed of the Oroonoko, and give rise to the rapids of Torno and of la Boca del Infierno *. I shall name successively from N.N.E. to S.S.W. the different chains which Mr. Bonpland and myself recognized in proportion as we approached the equator and the river of the Amazons. 1st. The most northern chain of the whole system of the mountains of Parime, appeared to us to be that which stretches (lat. $7^{\circ} 50'$), from the Rio Arui, in the meridian of the rapids of Camiseta, at the back of the town of Angostura, towards the great cataracts of the Rio Carony and the sources of the Imataca. In the missions of the Catalan Capucins,

* Vol. v, p. 687. To this series of advanced rocks those also belong which pierce the soil between the Rio Aquire and the Rio Barima; the granitic and amphibolic rocks of the Vieja Guayana and of the town of Angostura, the Cerro de Mono, on the south-east of Muitaco or Real Corona; the Cerro of Taramuto, near the Alta Gracia, &c. (Vol. v, p. 690, 754.)

this chain, which is not 300 toises high, separates the tributary streams of the Oroonoko and those of the Rio Cuyuni, between the town of Upata, Cupapui, and Santa Marta *. On the west of the meridian of the rapids of Camiseta (long. $67^{\circ} 10'$), the high mountains in the basin of the Rio Caura, only commence at $7^{\circ} 20'$ of latitude, on the south of the mission of San Luis Guaragua-raico, where they produce the rapids of Mura. This chain stretches towards the west by the sources of the Rio Cuchivero, the Cerros del Mato †, the Cerbatana and Maniapure, as far as *Tepupano*, a groupe of granitic rocks of strange forms, that surround the Encaramada. The culminant points of this chain (lat. $7^{\circ} 10' - 7^{\circ} 28'$) are placed, according to the information I gathered from the Indians, near the sources of Caño de la Tortuga. The *chain of the Encaramada* ‡, displays some traces of gold. It is also celebrated in the mythology of the Tama-naques; for the painted rocks it contains are associated with ancient geogonic traditions. The Oroonoko changes its direction at the confluence of the Apure, breaking a part of the chain of the Encaramada; the monticules and

* Vol. v, p. 760.

† Pl. 15, 16, and 20 of the Geographical Atlas, and the *Personal Narrative*, Vol. v, p. 673.

‡ Vol. iv, p. 460, 470; Vol. v, p. 827.

the scattered rocks in the plain of Capuchino *, and on the north of Cabruta, may be considered either as the vestiges of a destroyed *counter-fort*, or, (on the hypothesis of the igneous origin of granite,) as partial eruptions and heavings up. I shall not here discuss the question, whether the most northerly chain, that of Angostura and of the great fall of Carony, be a continuation of the chain of Encaramada. 3d. In navigating on the Oroonoko from north to south, we see small plains and chains of mountains † alternately on the east, of which we cannot distinguish the profiles, that is the section perpendicular to their longitudinal axis. From the mission of the Encaramada to the mouth of the Rio Qama, I reckoned seven times this alternating of savannahs, and high mountains. First, on the south of the isle Cucuruparu, rises the *chain of Chaviripe* (lat. $7^{\circ} 10'$); it stretches, inclining towards the south (lat. $6^{\circ} 20' - 6^{\circ} 40'$), by the Cerros del Corozal, the Amoco, and the Murcielago, as far as the Erevato, a tributary stream of the Caura. It there forms the rapids of Paru ‡, and is linked with the summits of Matacuna. 4th. The chain of Chaviripe is succeeded by that of Baraguan (lat. $6^{\circ} 50' - 7^{\circ} 5'$), celebrated for the strait of the Oroonoko to which it gives

* Vol. v, p. 675.

† Vol. iv, p. 468.

‡ Vol. v, p. 685.

its name. The Saraguaca, or mountain of Uruana, composed of detached blocks of granite, may be regarded as a northern counter-fort of the chain of Baraguan *, stretching on the south-west towards Siamacu, and the mountains (lat. $5^{\circ} 50'$) that separate the sources of the Erevato and the Caura from those of the Venituari. 5th. *Chain of Carichana and of Paruaci* (lat. $6^{\circ} 25'$), of a wild aspect, but surrounded by charming meadows. Piles of granite crowned with trees, and insulated rocks of prismatic form, (the Mogote of Cocuyza and the Mari-maruta † or *Castillito* of the jesuits), belong to this chain. 6th. On the western bank of the Oroonoko, which is low and flat, the Peak of Uniana rises abruptly more than 3000 feet high. The *counter-forts* (lat. $5^{\circ} 35' - 5^{\circ} 40'$) which this peak sends towards the east are crossed by the Oroonoko in the *first Great Cataract* (that of Mapura or the Atures); further on they join, and rising in a chain, stretch ‡ towards the sources of the Cataniapo, the rapids of Venituari, situated on the north of the confluence of the Asisi (lat. $5^{\circ} 10'$) and the Cerro Cunevo. 7th. Five leagues south of the Atures is the *chain of Quittuna §, or of May-*

* Vol. iv, p. 502; Vol. v, p. 554, 604.

† Vol. iv, p. 540, 544.

‡ Vol. v, p. 43, 55, 119.

§ Vol. v, p. 133, 166, 167, 554.

pures (lat. $15^{\circ} 13'$), which forms the bar of the *Second Great Cataract*. None of those lofty summits are placed on the west of the Oroonoko; on the east of that river rises the Cunavami, the truncated peak of Calitamini, and the Jujamari, to which father Gili attributes an extraordinary height. 8th. The last chain of the south-west part of the Sierra Parime is separated by woody plains from the chain of Maypures; it is that of the Cerros de Sipapo (lat. $4^{\circ} 50'$), an enormous wall, behind which the powerful chief of the Guaypunabis Indians intrenched himself during the expedition of Solano. The *chain of Sipapo* * may be considered as the beginning of the range of lofty mountains that bound, at the distance of some leagues, the right bank of the Oroonoko, where it runs from S. E. to N. W. between the mouth of the Venituari, the Jao, and the Padamo (lat. $3^{\circ} 15'$). In going up the Oroonoko, above the cataract of Maypures, long before we reach the point where it turns, near San Fernando del Atabapo, we find the mountains are removed from the bed of the river†, and from the mouth of the Zama there are only insulated rocks in the plains. The chain of Sipapo (if we consider the lofty summits as making a part of it,

* Vol. v, p. 174.

† Vol. v, p. 193.

which are seen constantly on the north * in navigating from Santa Barbara to the Esmeralda), forms the south-west limit of the system of mountains of Parime, between the $70\frac{1}{2}^{\circ}$ and 68° of longitude. The modern geognosts have observed that the culminant points of a groupe are placed less frequently at its centre than towards one of its extremities, preceding, and announcing in some sort, a great depression † of the chain. This phenomenon is again observed in the groupe of the Parime, the loftiest summits of which, the Duida and the Maraguaca, are in the range of the most southerly mountains, where the plains of Cassiquiare and Rio Negro begin.

These plains or savannahs, which are not covered with forests in the vicinity of the rivers, do not, however, display the same uniform continuity as the Llanos of the Lower Oroonoko, of the Meta, and of Buenos Ayres. They are interrupted by groupes of hills (Cerros de Daribapa ‡,) and by insulated rocks of grotesque forms §

* Vol. v, p. 613.

† Montblanc, Chimborazo.

‡ Lat. 3° , long. $69^{\circ} 12'$ between the Itiniveni or Conanchite and the sources of the Tama, a tributary stream of the Alacavi and the Atabapo.

§ Piedra de Kemarumo (lat. $3^{\circ} 20'$), Piedra de la Guahiba, Piedra de Astor, on the banks of the Atabapo; rocky wall of Guanari with two towers near the Rapids of Cunanivacari,

that pierce the soil, and fix from afar the attention of the traveller. These granitic, and often stratified masses, resemble pillars or edifices in ruins. The same force which heaved up the whole groupe of the Sierra Parime, has acted here and there in the plains as far as beyond the equator. The existence of these steeps and sporadic monticula, renders difficult the precise fixation of the limits of a system in which the mountains are not longitudinally ranged as in a vein. In proportion as we advance towards the frontier of the Portuguese province of Rio Negro the high rocks become more rare, and we no longer find the shelves or dykes of gneis-granite which cause rapids and cataracts in the rivers.

Such is the surface of the soil between the $68\frac{1}{2}^{\circ}$ and $70\frac{1}{2}^{\circ}$ of longitude, between the meridian of the bifurcation of the Oroonoko, and that of San Fernando de Atabapo; further on, westward of the Upper Rio Negro, towards the source of that river, and its tributary streams the Xiè and the Uaupes (lat. 1° — $2\frac{1}{4}^{\circ}$, long. 72° — 74°) lies a small mountainous table-land, in which Indian traditions place a *Laguna de oro*, that is a lake surrounded with beds of aurife-

Piedra de Culimacari (lat. $2^{\circ} 0' 42''$) on the banks of the Cassiquiare; Glorieta de Cocuy (lat. $1^{\circ} 40'$) and Piedra de Uinumane on the banks of the Rio Negro. (See Vol. v, p. 233, 242, 371, 372, 399, 400, 409, 412.)

rous earth*. At Maroa, the most westerly mission of the Rio Negro, the Indians assured me that that river, as well as the Inirida (a tributary stream of the Guavare), rises at the distance of five days march, in a country bristled with hills and rocks. The natives of San Marcellino speak of a Sierra Tunuhy, placed near thirty leagues west of their village, between the Xie and the Icanna. M. de Condamine heard also from the Indians of the Amazon, that the Quiquiari (Iquiari of Acuna and Fritz), comes from "a country of mountains and mines." Now, the Iquiari is placed by the French astronomer, between the equator and the mouth of the Xie (Ijié), which identifies it with the Iguiare that falls into the Icanna. We cannot advance in the geognostic knowledge of America, without having unceasingly recourse to the re-

* Vol. v, p. 312, 320, 330. According to the journals of Acuna, and Firtz, the Manaos Indians (Manoas) drew gold from the banks of the Yquiari (Iguiare or Iguare), of which they made blades. The manuscript notes of Don Apollinario also make mention of the gold of the Rio Uaupes. (La Condamine, *Voyage à l'Amazone*, p. 98, and 129; and above, Vol. v, p. 313, 320, 664.) We must not confound the *Laguna de Oro*, which is said to be found in going up the Uaupes (nor. lat. 0° 40') with another gold lake (south lat. 1° 10') which La Condamine calls *Marahi* or *Marachi* (water), and which is nothing but a soil often inundated, between the sources of the Jurubech (Urubaxi) and the Rio *Marahi*, a tributary stream of the Caqueta.

searches of comparative geography. The small system of mountains, which we shall call provisionally, that of the *sources of the Rio Negro and the Uaupes*, and the culminant points of which are not probably from 100 to 120 toises high *, appear to extend towards the south to the basin of Rio Yupura, where rocky ridges form the cataracts of the Rio de los Engaños and the Salto Grande de Yupura (south lat. $0^{\circ} 40'$ to north lat. $0^{\circ} 28'$), and the basin of the Upper Guaviare towards the west. We find in the course of this river, from 60 to 70 leagues west of San Fernando del Atabapo, two walls of rocks that bound the *strait* (nearly $3^{\circ} 10'$ nor. lat. and $73\frac{3}{4}'$ long.) where the excursion of father Maniella finishes. That missionary told me, that in going up the Guaviare, he perceived near the strait (Angostura), a chain of mountains bounding the horizon on the south. It is not known whether those mountains traverse the Guaviare more to the west, and join the *counter-forts* which advance from the eastern Cordillera of New Grenada, between the Rio Umadea and the Rio Ariari, towards the savannahs of San Juan de los Llanos. I doubt much of this communication; if it had taken place, the plains of the Lower Oroonoko would communicate with those of the Amazon only by a very

* Vol. v, p. 332.

narrow land-strait, on the east of the mountainous country which surrounds the source of the Rio Negro; but it is more probable that this mountainous country (a small system of mountains, geognostically dependent on the Sierra Parime), forms something of an island in the Llanos of Guaviare and Yupura. Father Pugnet, guardian of the convent of St. Francis at Popayan, assured me, that when he went from the missions settled on the Rio Caguan to Aramo, a village situated on the Rio Guayavero, he found only savannahs destitute of trees*, extending as far as the eye could reach. The chain of mountains placed by several modern geographers † no doubt to adorn their maps, between the Meta and the Vichada, and which appears to link the Andes of New Grenada with the Sierra Parime, is altogether imaginary.

We have now examined the prolongation of the Sierra Parime on the west, towards the source of the Rio Negro: it remains for us to follow the same groupe in its eastern direction. The mountains of the Upper Oroonoko, east-

* What forest do the maps place in those countries (*Selva Grande* or *El Ayrico*)? The whole territory between the Upper Oroonoko and the missions of Caqueta is so unknown, that the positions of San Juan de los Llanos, Caguan, Aramo, and the confluence of the Rio Fragua with the Yupura or Caqueta, may be more than half a degree false in latitude.

† For instance, the great map of *South America*, by Arrowsmith.

ward of the Raudal des Guaharibos (nor. lat. $1^{\circ} 15'$ long. $67^{\circ} 38'$), join the *chain of Pacaraina* (Pacarahina, Pacaraymo, Baracayna), which divides the waters of the Carony and the Rio Branco, and of which the micaceous schistus, resplendent in their silvery lustre, became so important in the fable of the Dorado of Raleigh*. The part of that chain containing the sources of the Oroonoko has not yet been explored; but its prolongation more to the east, between the meridian of the military post of Guirior and the Rupunuri, a tributary stream of the Essequibo, is known to me † by the tra-

* Vol. v, p. 797, 798, 841, 857.

† The following is a list of the unpublished materials on which I found my description of the eastern part of the Sierra Parime: 1^o Journal of Nicolas Hortsman (1740) found among d'Anville's papers (Vol. v, p. 594, 791), and communicated by his heirs. 2^o Written notes (1778) dictated by Santos, when he passed from the missions of Carony to the plains of Rio Branco, crossing the chain of Pacaraina, which he calls Pacaraymo (Vol. v, p. 572, 839, 840). This manuscript, and the following, are preserved in the archives of Nueva Guayana, whence I took copies. 3^o Journal of Don Nicolas Rodriguez, the friend of Santos, from Barcelonetta to the confluence of the Rio Mao (Mahu), and the Rio Branco, I traced a map on the very accurate indications of *rhumbs* and distances contained in this valuable manuscript. 4^o Two very detailed maps of the captain of the frigate, and the astronomical geographer of the Portuguese commission of the boundaries, Don Antonio Pires de Sylva Pontes Leme, and the captain of engineers, Don Ricardo Franco d'Almeida de

vels of two Spaniards, Don Antonio Santos, and Nicolas Rodriguez, and also by the geodesic labors of the Portugueze Pontes and Almeida. There are two portages little frequented, between the Rio Branco and the Rio Essequibo (the portages of Sarauru and the lake Amucu), on the south of the chain of Pacaraina; they facilitate the *road by land* that leads from the Villa of the Rio Negro to Dutch Guyana*. The portage, on the contrary, between the basin

Serra (1787 and 1804). These manuscript maps, containing the whole detail of the trigonometric survey of the windings of the rivers, were obligingly communicated to M. Lapie and myself, by the Count of Linhares. It may be affirmed, that the course of few rivers in Europe has been marked by more minute operations than that of the Rio Branco, the Ura-ricuera, the Yacutu, and the Maho; and we may regret that in the state of barbarism in which the geography of the vast countries of Spanish and Portugueze America yet are, a predilection for such rigorous precision has prevailed respecting a wild and almost uninhabited region. 5° Notes of the voyage made by Francisco Jose Rodriguez Barata, Lieutenant Colonel of the first regiment of the line at Para, when ensign, by the Rio Branco, the Tacutu, and the Sarauru, to Rio Rupunuri, and Surinam, in crossing (1793) the portage, or isthmus that separates on the south of Cerro Conucumu, the basins of the Rio Branco and the Essequibo (Vol. v, p. 480). I owe this information to the kindness of M. Brito, ambassador of Portugal at the court of France.

* The portage of the lake Amucu (Amacu), between the Caño Pirara, a tributary stream of the Rio Mahu and the Caño Tavaricuru or Tauricuru, is ten leagues north of the portage of Sarauru (Vol. v, p. 480).

of the Rio Branco, and that of the Carony, crosses the summit of the chain of Pacaraina. On the northern slope of this chain rises the Anocapra (Anuca-para? Nocaprai), a tributary stream of the Paraguamusi or Paravamusi; and on the southern slope, the Araicuque, which, with the Uraricapara, forms the famous *Valley of Inundations**, above the destroyed mission of Santa Rosa (lat. $3^{\circ} 46'$, long. $65^{\circ} 10'$). The principal Cordillera, which appears of little breadth, stretches on a length of 80 leagues, from the portage of Anocapra (long. $65^{\circ} 35'$) to the left bank of the Rupunuri (long. $61^{\circ} 50'$), following the parallels of $4^{\circ} 4'$ and $4^{\circ} 12'$.

* Vol. v, p. 791. The Rio Uraricapara throws itself into the Uraricuera, called *Curaricara* in the manuscript of Rodriguez, and which may be considered as the western branch of the Rio Branco, while the eastern branch is the Tacutu, which receives the Mahu. The two branches join near the fort of San Joaquim of the Rio Branco. The Spaniards of Carony began to pass the chain of Pacaraina, and fix themselves on the Portuguese territory, in the years 1770 and 1773. They established successively the missions of Santa Rosa, San Juan Baptista de Cayacaya (Cadacada) and San Antonio (Caulin, p. 60); but those villages, or rather assemblages of huts, were destroyed by the Portuguese. Wars are unhappily but too frequent in this part of America, between the neighbouring missions of two rival nations. The map of Pontes marks at the junction of the Paraguamusi and the Rio Paragua (a tributary of the Carony), the village of San Vicente, lat. $4^{\circ} 25'$; the point where the Spanish military post of Guirior is placed.

We there distinguish, from west to east, the mountains of Pacaraina, Tipique, Tauyana, where rises the Rio Parime (a tributary stream of the Uraricuera), Tubachi, Cristaux (lat. $3^{\circ} 56'$, long. $62^{\circ} 52'$), and Canopiri. The Spanish traveller, Rodriguez, marks the eastern part of the chain by the name of *Quimiropaca*; but as the geognostic description of a country cannot make any progress without adopting general names, I continue to give the name of Pacaraina to the whole of this Cordillera, which links the mountains of the Oroonoko, to those of the interior of the Dutch and French Guyanas, and which Raleigh and Keymis had made known in Europe at the end of the 16th century. This chain is broken by the Rupunuri and the Essequibo, so that one of their tributary streams, the Tavaricururu, takes its rise on the southern declivity, and the other, the Sibarona, on the northern. In approaching the Essequibo, the mountains are more developed towards the south-east, and extend beyond the $2\frac{1}{2}^{\circ}$ of north latitude. From this *eastern branch* * of the

* The culminant points of this eastern branch, are from S.E. to N.W.; the Sierras of Cumucumu, Xirivi, Yaviarna, Paranambo, Uanarari, and Puipe. I believe that the groupe of the mountains of Cumucumu (*Cum-Ucuamu*) in the map of Pontes, taken on the spot, is the *Cerro del Dorado* or *Cerro Ucuuamu* of the journal of Santos, and the *Acucuamo* of Caulin (*Corografica*, p. 176) between the Mahu and the Ru-

chain of Pacaraina the Rio Rupunuri rises near the Cerro Uassari. On the right bank of the Rio Branco, in a still more southern latitude (between 1° and 2° north) is a mountainous territory in which the Caritamini, the Padaviri, the Cababuri (Cavaburis) and the Pacimoni take their source, from east to west. This *western branch* of the mountains of Pacaraina separates the basin of Rio Branco from that of the Upper Oroonoko, of which the sources are probably not found on the east of the meridian of $66^{\circ} 15'$: it is linked with the mountains of Unturan and Yumariquin, lying S.E. of the mission of Esmeralda*. From the whole of these

punuri. The Isle Ip-*Amucena*, which Santos places in the middle of the Laguna Parime, recalls the name of lake *Amuca* (Amueena, Amacu), of which the existence, already announced by the surgeon Hortsman de Hildesheim, has been certified by the most recent travels. (Vol. v, p. 791, 799.)

* The Indians who inhabit the banks of the Rio Branco, told M. Pontes that the Rio Mocajahi or Cahuana, which flows into the Rio Branco, at $2^{\circ} 26'$ of latitude, and which the Portuguese soldiers ascended in canoes during twenty days, over innumerable rapids and cataracts, communicates with the Cababury, which is at once a tributary stream of the Rio Negro and the Cassiquiare, (See above, Vol. v, p. 377, 418.) If this notion be correct, our maps prolong the course of the Padaviri much too far towards the north. It furnishes, according to the author of the *Corographia brasiliensis* (Vol. ii, p. 349), a portage to the Umavaca (no doubt the Macava, a tributary stream of the Upper Oroonoko). I am surprised at the detail

considerations it results, that while on the west of the Cassiquiare, between that river, the Atabapo, and the Rio Negro, we find only vast plains, in which rise some monticules and insulated rocks; real counter-forts stretch on the east of the Cassiquiare, from N.W. to S.E. and form a continued mountainous territory as far as the 2° of north latitude. The basin only, or rather the transversal valley of Rio Branco, forms a kind of gulph, a succession of plains

given in Arrowsmith's map, of the sources of the Padaviri, placed in 3° latitude, while in the manuscript maps of Pontes these sources are marked at 1½°. Heretofore the Daraha, the Padaviri, and the Uaraca, were supposed to join the Rio Branco, having three distinct mouths, and forming a delta of tributary streams. (See *Surville's map*, which accompanies the *Corography of Caulin*). The great inundations of Seriveni and Caritamini (lat. 1°—2° north) have no doubt given rise to the fable of lake Mauvatu, on the map of the Amazon traced by M. Requena, first commissary of the boundaries in the service of the King of Spain. These inundations, and the uniform assertion of the Indians, that the Rio Mocajahi communicates with the Cababury, may also have contributed to the hypothesis of the imaginary lake which Surville places west of the Rio Branco, and which he links at the same time to that river and the Oroonoko (Vol. v, p. 851). I shall here observe, that the lake Amuca of Hortsman, and the two upper branches of the Rio Branco, the Uraricuera and the Mahu, which is the classical country of *Dorado of Raleigh*, are found, according to the astronomical observations of Portuguese travellers, between the parallels 3° and 4°, while Surville's map enlarged that space from 4° to the equator.

and savannahs (*campos*) several of which penetrate into the mountainous land, from south to north, between the eastern and western branches of the chain of Pacaraina, to the distance of 8 leagues north of the parallel of San Joaquin *.

We have just examined the southern part of the vast *system of the mountains of Parime*, between the 2° and 4° of latitude, and between the meridians of the sources of the Oroonoko and the Essequibo. The developement of this system of mountains towards the north, between the chain of Pacaraina and the Rio Cuyuni, and between the meridians 66° and 61 $\frac{3}{4}$ °, is still much more unknown. The only road frequented by white men is that of the river Paragua, which receives the Paraguamusi, near the Guirior. We find indeed, in the journal of Nicolas Rodriguez, that he was constantly obliged to have his canoe carried by men (*arrastrando*) by the cataracts which intercept the navigation †; but we must not forget a

* We find savannahs between the Mayari and the Tacutu, but east and west of those rivers, between the Tacutu and the Rupunuri, the country is full of mountains. In considering the whole chain of Pacaraina, we observe that the eastern groupe, that of Cerro Cumucumu, is much loftier than the western, which contains the sources of the Caritamini.

† In ascending from Barcelonetta to the portage between Anocapra (no doubt *Anoca-para*, water of *Anoca*), and Arai-cuque, across the Sierra Pacaraina, we find along the banks

circumstance, of which my own experience furnished me with frequent proofs,—that the cataracts in this part of South America are often caused only by ridges of rocks which do not form real mountains. Rodriguez names but two between Barcelonetta and the mission of San Jose ; while the missionaries place more to the east, in 6° latitude, between the Rio Carony and the Cuyuni * the Serranias of Usupama and Rinocote. The latter crosses the Mazaruni, and forms 39 cataracts in the Essequibo †, from the military post of Arinda (lat. 5° 30') to the mouth of Rupunuri.

With respect to the continuation of the system of the mountains of Parime, south-east of the meridian of the Essequibo, the materials are entirely wanting for tracing it with

of the Paragua and the Paraguamusi, from north to south, the confluence of the Carony and the Rio Paragua ; the mouth of the Rio Hore ; the Cerro Paragua, near the western bank of Paragua ; Raudals of Orayma, Guayquirima, and Carapo ; the Cerro del Gallo ; the village of San Jose ; the mouth of Caño de Espuma ; the Raudals of Guayguari and Para ; the great Raudal of Mayza ; the Boca of Caño Icapra ; the Boca of Paraguamusi, and the Raudals of Anocapra. (*Razon de lo que ha sucedido a Don Nicolas Rodriguez durante su navegacion en el Rio Paragua y en las Misiones altas de los Reverendos Padres Capuchinos de Carony, fol. 7-15 manuscript*).

* Map which accompanies father Caulin's work.

† Van Buchenræder, Map of the Colony of Essequibo, 1798.

precision. The whole interior of the Dutch, French, and Portuguese Guyanas, is a *terra incognita*; and the astronomical geography of those countries has scarcely made any progress during thirty years*. If the American limits recently fixed † between France and Portugal, should one day cease to belong to the illusions of diplomacy, and acquire reality, in being traced on the territory by means of astronomi-

* It is certain that M. Le Blond, correspondent of the Academy of Sciences, in going up the river Oyapock, notwithstanding all his zeal, only reached a little beyond the mouth of the Suacari. The sources of the Araguari (Araouari), the Oyapock, the Camopi, and the Tamouri (tributaries of the Oyapock), and the Araouna (tributary of the Maroni), are very near each other, in $2^{\circ} 30'$ latitude, and $35^{\circ} 10'$ longitude. A voyage of discovery should be made from this point of French Guyana, towards the confluence of the Rio Branco with the Rio Negro, in the direction S. 75° W., on a distance of 220 leagues. The borders of French Guyana lie between Cape Orange and the mouth of the Maroni, S. E. and N. W. Now, in a perpendicular direction to the shore of Cayenne, none of the *pretended great expeditions of the interior* have led white men beyond Mount Tripoupou and the post of the Roukoyenes Indians, at the distance of more than 70 leagues! The communications opened by land between the Capitania of Rio Negro and the shore of Guyana have been directed solely along the Rio Essequibo, on account of the facility furnished by the proximity of its tributary streams to those of the Rio Branco.

† In consequence of the treaty of Vienna. See above, Vol. v, p. 342.

cal observations, (as was projected in 1817,) this undertaking would lead geographical engineers to that unknown region which, at $3\frac{1}{2}^{\circ}$ west of Cayenne, divides the waters between the coast of Guyana and the Amazon. Till that period, which the political state of Brazil seems to retard, the geognostic table of the groupe of Parime can only be completed by scattered notions collected in the Portuguese and Dutch colonies. In going from the Uassarí mountains (lat. $2^{\circ} 25'$, long. $61^{\circ} 50'$) which form a part of the eastern branch of the Cordillera of Pacaraina, we find towards the east, a chain of mountains called by the missionaries *Acaray* and *Tumucuraque* *. Those two names wander on our maps between $0\frac{1}{2}^{\circ}$ and 3° of

* The Sierra *Tumucuraque* (Tumumucuraque of Caulin, Tumucucuraque of Arrowsmith) appeared for the first time on the map of La Cruz; and, as the name is there twice placed with a difference of 3° of latitude, this double nomination has been religiously repeated on the maps of Surville, Buache, &c. The geographer Sanson, who, in his *Course of the river of the Amazons, traced from the narrative of father Acuna* (1680), had the merit, in suppressing the lake Parime and the Sierra Wacarima (Pacarahina) which had till then been figured in the direction of a meridian, to have first traced with some precision, a chain of mountains stretching parallel to the equator, between the northern sources of the Essequibo, Maroni, and Viapoco (Oyapock), and the southern sources of the Urixamina (R. de Trombetas), of Curapatuba, and of the Ginipape or Rio Paru.

north latitude. Raleigh first made known* in 1596, the system of the mountains of Parime, between the sources of the Rio Carony and the Essequibo, by the name of Wacarima (Pacarima); and the jesuits Acuna and Artedia furnished, in 1639, the first precise notions of that part of this system which extends from the meridian of Essequibo to that of Oyapock†. There they place the mountains of Yguaracuru and Paraguxo, the former of which gives birth to a gold river (*Rio de oro*), a tributary stream of the Curupatuba‡; and according to the assertion of the natives, subterraneous noises are sometimes heard from the latter. The ridge of this chain of mountains, which may be followed in a direction S. 85° E., from the peak Duida, near the Esmeralda (lat. 3° 19'), to the

* Vol. v, p. 797, &c.

† Vol. v, p. 865.

‡ When we know that in Tamanac gold is called *caricuri*; in Carib, *caricura*; in Peruvian, *cori* (*curi*), we easily recognize in the names of the mountains and rivers (Yguara-curu, Cura-patuba), which we have just marked, the indication of an auriferous soil. Such is the analogy of the *imported roots* in the American tongues, which otherwise differ altogether from each other, that 300 leagues west of the mountain Ygaracuru, on the banks of the Caqueta, Pedro de Ursua heard of the province of *Caricuri*, rich in gold washings. (Vol. v, p. 823). The Curupatuba falls into the Amazon near the Villa of Monte Alegre, N. E. of the mouth of the Rio Topayos.

rapids of the Rio Manaye, near cape Nord (lat. $1^{\circ} 50'$), divides, in the parallel 2° , the northern sources of the Essequibo, the Maroni, and the Oyapock, from the southern sources of the Rio Trombetas, Curupatuba, and Paru. The most southern counter-forts of this chain draw nearer the Amazon, at the distance of fifteen leagues. These are the first heights that we perceived after having left Xeberos and the mouth of the Huallaga*. They are constantly seen in navigating from the mouth of the Rio Topayo towards that of Paru, from the town of Santarem to Almeirim. The peak Tripoupou† is placed nearly in the meridian of the former of those towns, and is celebrated among the Indians of Upper Maroni. More to the east, at Melgaço, the Serras do Velho and do Paru‡ are still distinguished in the horizon. The real limits of this series of sources of the Rio Trombetas

* Vol. vi, p. 431. See also La Condamine's, *Voyage to the Amazon*, p. 143. The distance at which we see those counter-forts gives them 200 toises of absolute height. They are, however only, says Condamine, the anterior hills of a long chain of mountains extending from west to east, and of which the summits form the points of partition of the waters; the northern waters flow towards the coast of Cayenne and Surinam, and the southern towards the Amazon.

† Lat, $2^{\circ} 10'$, long. $1^{\circ} 36'$ west of the meridian of Cayenne, according to the map of Guyana, published at the *Depôt of the Marine*, 1817.

‡ *Corographia Brazil*, Vol. ii, p. 297.

are better known towards the south than the north, where a mountainous country appears to advance in Dutch and French Guyana, as far as from 20 to 25 leagues of the coast. The numerous cataracts of the rivers of Surinam, Maroni, and Oyapock, prove the extent and the prolongation of rocky ridges ; but nothing hitherto indicates that there exists in those regions (as sometimes has been hastily announced), *continued plains*, or table-lands some hundred toises high, fitted for the cultivation of the plants of the temperate zone.

I have just collected into one geognostic table all the materials I possess on the *system of the mountains of Parime*. Its extent surpasses nineteen times that of the whole of Switzerland ; and even considering the mountainous groupe of the sources of the Rio Negro and the Xie as independent or insulated amidst the plains, we still find the Sierra Parime (between Maypures and the sources of the Oyapock) to be 340 leagues in length, and its greatest breadth (the rocks of Imataca, near the delta of the Oroonoko, at the sources of the Rio Paru) 140 leagues. In the groupe of the Parime, as well as in the groupe of the mountains of central Asia, between the Himalaya and the Altai, the partial chains are often interrupted, and present no constant parallelism. Towards the south-west however, (between the strait of

Baraguan, the mouth of the Rio Zama, and the Esmeralda) the line of the mountains is generally in the direction of N. 70° W. Such is also the position of a distant coast, that of the Portugueze, French, Dutch, and English Guyanas, from Cape North to the mouth of the Oroonoko; such is the mean direction of the course of the Rio Negro and Yupura. I wish to fix the attention of geognosts on the angles formed by the partial chains, in different regions of America, with the meridians; because on less extended surfaces, for instance in Germany *, we find also this singular co-existence of groupes of neighbouring mountains which follow laws of direction altogether different, although we observe in every groupe insulately, the greatest uniformity in the line of chains.

The soil on which the mountains of Parime rise, is slightly convex †. I found by barometric measures, that between 3° and 4° of north latitude, the plains are elevated from 160 to 180 toises above the level of the sea. This height will appear considerable if we reflect that at the foot of the Andes of Peru, at Tomependa, 900 leagues distant from the coast of

* Leopold von Buch, *uber Dolomit*, zweite Abhoudl., 1823, p. 54.

† *Recueil d'Obs. astronomiques*, Tom. ii, p. 298. *Personal Narrative*, Vol. v, p. 252, 550.

the Atlantic Ocean, the Llanos or plains of the Amazon rise only 194 toises *. What most characterizes the groupe of the mountains of Parime are the rocks of granite and gneiss-granite, the total absence of calcareous secondary formations, and the shelves of bare rock (the *Tsy* of the Chinese deserts), which fill on the surface, immense spaces in the savannahs †.

ε. GROUPE OF THE MOUNTAINS OF BRAZIL. This groupe has hitherto been figured on the maps in as singular a manner as the mountains of the Iberian Peninsula, Asia Minor and Persia. The temperate table-lands and real chains of 300 to 500 toises high, have been confounded with countries excessively hot, and of which the undulating surface presents only ranges of hills variously grouped. The excellent barometric measures of Baron Eschwege, director general of the gold mines in the province of Minas Geraes, and the observations made in different parts of Brazil, by the prince of Neuwied, MM. Auguste de Saint Hilaire, Olfers, Spix, Pohl, and Martius, have recently thrown great light on the orography of Portuguese America. The mountainous region of Brazil, of which the mean height rises at least

* Vol. vi, p. 395.

† Vol. iv, p. 552; and v, p. 26.

to 400 toises, is comprehended within very narrow limits, nearly between 18° and 28° south latitude; it does not appear to extend, between the provinces of Goyaz and Mato-Grosso, beyond 53° of longitude, west of the meridian of Paris.

When we regard in one view the eastern configuration of both Americas, we perceive that the coast of Brazil and Guyana, from Cape Saint Roque to the mouth of the Oronoko (stretching S. E. to N. W.), corresponds with that of Labrador, as the coast from Cape Saint Roque to the Rio de la Plata corresponds with that of the United States (stretching from S. W. to N. E.). The chain of the Alleghanies is opposite to the latter coast, as the principal Cordilleras of Brazil are nearly parallel to the shore of the provinces of Porto Seguro, Rio Janeiro, and Rio Grande. The Alleghanies, generally composed of grauwakke and transition rocks, are a little loftier than the almost primitive mountains (of granite, gneiss, and micaslate,) of the Brazilian groupe; they are also of a far more simple structure, their chains lying nearer each other, and preserving, as in the Jura, a more constant parallelism.

If, instead of comparing those parts of the New Continent situated north and south of the equator, we confine ourselves to South America, we find on the western and northern coasts in

their whole length, a continued chain near the shore (the Andes and the Cordillera of Venezuela), while the eastern coast presents masses of more or less lofty mountains only between the 12° and 30° of south latitude. In this space of 360 leagues in length, the system of the mountains of Brazil corresponds geognostically in its form and position, with the Andes of Chili and Peru. Its most considerable portion lies between the parallels 15° and 22° , opposite the Andes of Potosi and la Paz, but its mean height is five toises less, and cannot even be compared with that of the mountains of Parime, Jura, and Auvergne. The principal direction of the Brazilian chains, where they attain the height of four to five hundred toises, is from south to north, and from south-south-west to north-north-east; but, between 13° and 19° the chains are considerably enlarged, and at the same time lowered towards the west. The ridges and ranges of hills seem to advance beyond the land straits which separate the sources of the Rio Araguay, Parana, Topayos, Paraguay, Guapore, and Aguapehy, in 63° of longitude. The western widening of the Brazilian groupe, or rather the undulations of the soil in the Campos Parecis, corresponding with the *counterforts* of Santa Cruz, of Sierra, and Beni*,

* Vol. vi, p. 421, 431.

which the Andes send towards the east, it was heretofore concluded that the system of the mountains of Brazil was linked with that of the Andes of Upper Peru. I partook myself of this error in my first geognostic labours.

A coast chain (*Serra do Mar*) extends nearly parallel with the coast, north-east of Rio Janeiro, lowering considerably towards Rio Doce, and losing itself almost entirely near Bahia (lat. $12^{\circ} 58'$). According to Mr. Eschwege*, some small ridges reach Cape Saint Roque (lat. $5^{\circ} 12'$). South-east of Rio Janeiro, the *Serra do Mar* follows the coast behind the Isle Saint Catherine as far as Torres (lat. $29^{\circ} 20'$); it there turns towards the west and forms an elbow stretching by the Campos of Vacaria, towards the banks of the Jacuy†.

Another chain lies west of the shore chain of Brazil, the most lofty and considerable of all, that of Villarica‡, which Mr. Eschwege marks by

* *Geognostisches Gemälde von Brasilien*, 1822, p. 5. The limestone of Bahia abounds in lignites. *Id.* p. 9.

† *Manuscript notes of M. Auguste de Saint Hilaire*. I owe to that great naturalist, whose extended views comprehended all that interests physical geography, some important rectifications of my sketch on the Brazilian system of mountains.

‡ Height of the town above the level of the sea, 630 toises. This height proves that Villarica is placed in the chain itself (*Serra do Espinhaço*), for the table-land of Mi-

the name of *Serra do Espinhaço*, and considers as the principal part of the whole structure of the mountains of Brazil. This Cordillera loses itself towards the north*, between Minas Novas and the southern extremity of the Capitania of Bahia, in 16° of latitude. It there remains more than 60 leagues removed from the coast of Porto Seguro; but towards the south, between the parallels of Rio Janeiro and Saint Paul (lat. 22° — 23°), in the knot of the mountains of Serra da Mantiqueira, it draws so near the Cordillera of the shore (*Serra do Mar*) that they are almost confounded together. In the same manner the *Serra do Espinhaço* follows constantly the direction of a meridian, towards the north; while towards the south, it runs south-east, and terminates towards 25° of latitude. The chain reaches its highest elevation between 18° and 21° ; and there, the counterforts and table lands at its back are of suffi-

nas Geraes, or the counterforts that unite the *Serra do Espinhaço* to that of Goyaz or *dos Vertentes*, are generally only 300 toises of absolute height. (*Eschwege, Journal von Brasilien*, 1818, Vol. ii, p. 213.)

* The rocky ridges that form the cataract of Paulo Affonso, in the Rio San Francisco, are supposed to belong to the northern prolongation of the *Serra do Espinhaço*, as a series of heights in the province of Seara, or fetid calcareous rocks containing a quantity of petrified fish, belong to the *Serra dos Vertentes*.

ent extent to furnish lands for cultivation where temperate climates prevail by degrees, that may be compared with the delicious climates of Xalapa, Guaduas, Caraccas, and Caripe. This advantage, which depends at once on the widening of the mass of the chain, and of its counterforts, is no where found in the same degree, on the east of the Andes, not even in chains of a more considerable absolute height, for instance in those of Venezuela and the Oronoko. The culminant points of the *Serra do Espinhaço*, in the Capitania of Minas Geraes, are the Itambe (932 t.), the Serra da Piedade, near Sabara (910 t.), the Itacolumi, properly Itacunumi (900 t.), the Pico of Itabira (816 t.), the Serras of Caraça, Ibitipoca, and Papagayo. M. Auguste de Saint Hilaire felt a piercing cold in the month of November, therefore in summer, in the whole Cordillera of Lapa, from the Villa do Principe to the Morro of Gaspar Suares*.

We have just recognized two chains of mountains nearly parallel, but of which the most extensive (that of the shore) is the least lofty. The capital of Brazil is situated at the point where the two chains draw nearest, and are linked together on the east of the Serra de

* Sketch of a voyage to Brazil. p. 5. Eschwege, p. 5, 29-30, and above, Vol. v, p. 858 ; Vol. vi, p. 402.

Mantiqueira, if not by a transversal ridge, at least by a mountainous territory. According to ancient systematic ideas on the rising of mountains, in proportion as we advance into a country, it was supposed that a *central Cordillera* existed in the Capitania of Mato Grosso, much loftier than that of Villarica or *do Espinhaço*; but we now know (and this is confirmed by climateric circumstances) that there exists no continued chain, properly speaking, to the westward of Rio San Francisco, on the frontiers of Minas Geraes and Goyaz. We find only a groupe of mountains of which the culminant points are the Serras da Canastra (south-west of Paracatu) and da Marcella (lat. $18\frac{1}{2}^{\circ}$ and $19^{\circ}10'$), and further north, the Pyreneos stretching from east to west (lat. $16^{\circ}10'$ between Villaboa and Mejaponte). Mr. Eschwege has named the groupe of mountains of Goyaz the *Serra dos Vertentes*, because it divides the waters between the southern tributary streams of the Rio Grande or Parana, and the northern tributary streams of Rio Tucantines. It runs towards the south beyond the Rio Grande (Parana), and approaches in 23° latitude, by the *Serra do Franca*, the *Espinhaço*. It attains only 300 to 400 toises of height, with the exception of some summits N. W. of Paracatu, and is consequently much lower than the chain of Villarica.

Further on, west of the meridian of Villaboa, there are only ridges and a series of monticules which, on a length of 12° , form the *threshold* or division of water (lat. 13° — 17°), between the Araguay and the Paranaiba (a tributary stream of the Parana), between the Rio Topayos, and the Paraguay, between the Guapore and the Aguapehy. The Serra of S. Martha (long. $15\frac{1}{2}^{\circ}$) is somewhat lofty, but geographers, or rather the drawers of maps, have preserved the habit of singularly exaggerating the height of the *Serras* or *Campos Parecis*, on the north of the towns of Cuyaba and Villabella (lat. 13° — 14° , long. 58° — 62°). These Campos, which have taken their name from that of a tribe of wild Indians *, are vast barren table-lands, entirely destitute of vegetation, and in which the sources † of the tributary streams of three

* *Patriota*, 1813, No. 1, p. 48 ; No. 6, p. 40, 51. The western part of these *Campos* is called *Urucumanacua*, between the Secury and the Camarare, two tributary streams of the Rio Topayos.

† The neighbouring tributary streams of the Topayos are the Jurucna, and the Camarare ; those of Madeira, the Alegre, the Guapore, and the Sarare ; those of Paraguay, the Aguapehy, the Jauru, and the Sipotobu. Villabella, of which the position may one day become important for the inland trade between the Amazon and the Rio de la Plata, is placed (lat. $15^{\circ} 0'$, long. $62^{\circ} 18'$) on the right bank of the Guapore or Itenes, a little above the confluence of the Sarare. On the south of Santa Barbara, the Aguapehy (a tributary stream

great rivers, the Topayos, the Madeira, and the Paraguay, take their rise. The learned author of the statistical description of the Capitanía of Mato Grosso, M. Almeida Serra, calls * *Atlas Serranias* (high mountains), those of the banks of the Aguapehy; but we must not forget, that in a flat country, mountains of 500 feet high appear lofty; above all, if (like the rocks of Baraguan and the Morros of San Juan †) the mass is inconsiderable. The most recent manuscript maps of Brazil place, 1st. the Serra da

of the Paraguay and the Rio de la Plata), approaches so near the Rio Alegre, (a tributary of the Guapore and the Amazon), that the portage is only 5322 *braças* long. A canal was there attempted to be traced during the ministry of Count de Barca (*Eschwege, Gemdlde*, p. 7); a circumstance that would not prove alone, the absence of chains of mountains, for openings and transversal valleys are found in the greatest Cordilleras. A degree below the confluence of the Paraguay and the Jauru, which receives the Aguapehy, a marshy soil begins. It extends as far as Albuquerque, and its inundations (lat. 17°—19°) have given rise to the fable of the Laguna de Xarayes, as the inundations of the Rio Parime (Rio Branco), gave birth to the fable of the Laguna Parime (Mar del Dorado or Rupunuwini). See *Patriota*, 1813, No. 5, p. 33, and *manuscript Map of Brazil, taken from 76 particular maps, at the depôt of Maps of Rio Janeiro, by Silvan Pontes Leme, 1804.*

* Geographical and political view of the Capitanía of Mato Grosso (1791), by the serjeant-major of engineers, Ricardo Francisco de Almeida Serra.

† In the Lower Oroonoko and in the Llanos of Venezuela. See above, Vol. iv, p. 279, 503.

Melguera or *dos Limites*, on the west of Villabella, between the Guapore and the Baures; 2d. the Serra Baliza, between the Buenos and the Alegre; and 3d. the Cordillera of San Fernando, between the ancient missions of San Juan Bautista and San Jago (lat. 16° — 20°) advancing in the province of Chiquitos to $64\frac{1}{2}^{\circ}$ of longitude, and approaching within 40 leagues distance of the counterfort of the Andes of Santa Cruz of Sierra; but these labours, although executed at the hydrographic Depôt of Rio Janeiro, do not merit much confidence in the western regions of Brazil, that *terra incognita*, which extends from Cochabamba to Villabella. The form of the insulated mountains in the plains of Chiquitos, the lakes between the missions of San Rafael, San Jose, and San Juan Bautista, copied from d'Anville and La Cruz, are become *stereotypes* on every map for eighty years past; and it is certain that a land-strait, a plain covered with some hills, in 62° and 66° of longitude, unites the great basins of La Plata and the Amazon. M. Eschwege obtained precise information from some Spanish planters, who came from Cochabamba to Villabella, on the continuity of those basins or savannahs.

According to his measures and geognostic observations, the high summits of the *Serra do Mar* (the coast chain) scarcely attain 660

toises ; those of the *Serra do Espinhaço* (chain of Villarica), 950 toises ; those of *Serra do los Vertentes* (groupe of Canastra and the Brazilian Pyrenees) 450 toises. Further west, the surface of the soil seems to present but slight undulations ; but no measure of height has been made beyond the meridian of Villaboa. Considering the system of the mountains of Brazil in their real limits (as we have indicated above), we find, except some conglomerates, the same absence of secondary formations with which we were struck in the system of the mountains of the Oroonoko (groupe of Parime). These secondary formations, which rise to considerable heights in the Cordillera of Venezuela and Cumana, belong to the low regions only of Brazil *.

B. *Plains (Llanos) or Basins.*

We have now successively examined, in that part of South America situated on the east of the Andes, *three systems of mountains*, those of the shore of Venezuela, Parime, and Brazil ; we have seen that this mountainous region, which equals the Cordillera of the Andes, not in mass, but in *area* and horizontal section of surface, is three times less elevated, much poorer in precious metals adhering to the rock,

* *Eschwege*, p. 15.

destitute of recent traces of volcanic fire, and, with the exception of the coast of Venezuela, little exposed to the violence of earthquakes. The mean height of the three systems diminishes from north to south, from 750 to 400 toises * ; those of the culminant points (*maxima* of the height of each groupe), from 1350 to 1000 or 900 toises. It results from these observations, that the loftiest chain, with the exception of the small insulated system of the Sierra Nevada of Santa Marta †, is the Cordillera of the shore of Venezuela, which is itself but a continuation of the Andes. In taking a view of the north, we find in central America (lat. 12° — 30°), and north America (lat. 30° — 70°), on the east of the Andes of Guatimala, Mexico, and Upper Louisiana, the same regular lowering which struck us towards the south. In this vast extent of land from the Cordillera of Venezuela to the polar circle, eastern America presents two distinct systems, the groupe of the mountains of the West Indies, of which the eastern part is volcanic, and the chain of the Alleghanies. The former of these systems, partly overwhelmed in the floods, may be compared with respect to its relative position and form, to the Sierra Parime ; the latter to the chains of Brazil, run-

* See above, Vol. vi, p. 405.

† See above, Vol. vi, p. 481.

ning alike from S. W. to N. E. The culminant points of those two systems rise to 1138 and 1040 toises. Such are the elements of this curve, of which the convex summit is placed in the chain of the shore of Venezuela :

AMERICA, ON THE EAST OF THE ANDES.

| SYSTEMS OF MOUNTAINS. | MAXIMA OF HEIGHTS. |
|--------------------------------------|--|
| Groupe of Brazil..... | Itacolumi 900 t. (south lat. $20\frac{1}{2}^{\circ}$). |
| Groupe of Parime..... | Duida..... 1300 (north lat. $3\frac{1}{4}^{\circ}$). |
| Chain of the shore of Venezuela..... | Silla de Caraccas.... 1350 (north lat. $10\frac{1}{2}^{\circ}$). |
| Groupe of the West Indies... | Blue Mountains..... 1138 (north lat. $18\frac{1}{6}^{\circ}$). |
| Chain of the Alleghanies | Mount Washington. 1040 (north lat. $44\frac{1}{4}^{\circ}$). |

I have preferred indicating in this table the culminant points of each system, to the mean height of the line of elevation ; the culminant points are the results of direct measures, while the mean height is an abstract idea somewhat vague, above all when there is only one groupe of mountains, as in Brazil, Parime, and the West Indies, and not a continued chain. Although

it cannot be doubted that among the five systems of mountains on the east of the Andes, and of which one only belongs to the southern hemisphere, the chain of the shore of Venezuela is the most elevated (having a culminant point of 1350 toises, and a mean height from the line of elevation of 750), we yet recognize with surprise, that the mountains of eastern America (whether continental or insulary), differ very inconsiderably in height above the level of the Ocean. *The five groupes are all nearly of a mean height of from five to seven hundred toises ; and the culminant points (maxima of the lines of elevation), from one thousand to thirteen hundred toises.* That conformity of construction on an extent twice as great as Europe, appears to me a very remarkable phenomenon. No summit on the east of the Andes of Peru, Mexico, and Upper Louisiana, enters within the limit of perpetual snow *. It may be added, that with the exception of the Alleghanies, no snow falls sporadically in any of the eastern systems which

* Not even the *White Mountains* of the state of New Hampshire, to which Mount Washington belongs. Long before the accurate measurement of Captain Partridge, I had proved (in 1804), by the laws of the decrease of heat, that no summit of the *White Mountains* could attain the height assigned to them by M. Cutler, of 1600 toises. (See my Spanish memoir : *Ideas sobre el limite inferior de la nieve perpetua* in *l'Aurora* à *Correo de la Havana*, No. 220, p. 142.)

we have just examined. From these considerations it results, and above all, from the comparison of the New Continent with those parts of the ancient which we know best, with Europe and Asia, that America thrown into the *aquatic hemisphere** of our planet, is still more remarkable by the continuity and extent of the depressions of its surface, than by the height and continuity of its longitudinal ridge. The mountains beyond and within the isthmus of

* The southern hemisphere, on account of the unequal distribution of seas and continents, has long been marked as an hemisphere eminently aquatic; but the same inequality is found when we consider the globe as divided not according to the equator but by meridians. The great masses of land are joined together between the meridian of 10° west, and 150° east of Paris, while the hemisphere eminently aquatic, begins on the west of the meridian of the coast of Greenland, and ends on the east of the meridian of the eastern coast of New Holland and the Kurile Isles. This unequal distribution of land and water has the greatest influence on the distribution of heat on the surface of the globe, on the inflexions of the isotherm lines, and the climateric phenomena in general. For the inhabitants of the centre of Europe the aquatic hemisphere may be called western, and the land hemisphere eastern; because in going to the west we reach the former sooner than the latter. It is the division according to meridians, which is intended in the text. Till the end of the 15th century, the western hemisphere was as much unknown to the nations of the eastern hemisphere, as one half of the lunar globe is to us at present, and will probably always remain.

Panama, but on the east of the Cordillera of the Andes, scarcely attain, on 600,000 square leagues, the height of the Scandinavian Alps, the Carpathes, Monts-Dores (in Auvergne), and the Jura. One system only, that of the Andes, unites in America on a long and narrow zone of 3000 leagues, all the summits which are more than 1400 toises high. In Europe, on the contrary, even considering, with too systematic views, the Alps and Pyrenees as one sole line of elevation, we still find summits far from this line or principal ridge, in the Sierra Nevada of Grenada, Sicily, Greece, the Appenines, perhaps also in Portugal, from 1500 to 1800 toises high*. The contrast between America and Europe, with respect to the distribution of the culminant points which attain 1300 to 1500 toises, is the more striking as the low eastern mountains of South America, of which the

* Culminant points ; Mulhacan of Grenada, 1826 toises ; Etna, according to Captain William Henry Smith, 1700 t. Monte Corno of the Appenines, 1489 t. If Mont Tomoros in Greece and the Serra Gaviarra of Portugal, enter, as is asserted, within the limit of perpetual snows (*Pouqueville*, Tom. ii, p. 242, and *Balbis*, *Essai statistique sur le Portugal*, Tom. i, p. 68, 98), those summits, according to their position in latitude, should attain 1400 to 1600 toises. Yet on the loftiest mountains of Greece, the Tomoros, the Olympus of Thessalia, the Polyanos of Dolopes, and Mount Parnassus, M. Pouqueville saw, in the month of August, snow preserved only in stripes, or in cavities sheltered from the rays of the sun.

maxima of the elevation is only from 1300 to 1400 toises, are placed on the side of a Cordillera of which the *mean height* exceeds 1800 toises, while the secondary system of the mountains of Europe rises to *maxima of elevation* of 1500 to 1800 toises, near a principal chain of 1200 toises at least of *mean height*.

MAXIMA OF THE LINE OF ELEVATION IN THE SAME PARALLELS.

- | | |
|--|--|
| <i>Andes of Chili and Upper Peru.</i> Knots of mountains of Porco and Cuzco, 2500 toises. | <i>Groupe of the Mountains of Brazil,</i> a little lower than the Cevennes, 900 to 1000 toises. |
| <i>Andes of Popayan and Cundinamarca.</i> Chain of Guacas, Quindiu, and Antioquia. More than 2800 t. | <i>Groupe of the Mountains of Parime,</i> little lower than the Carpathes, 1300 t. |
| <i>Insulated groupe of the snowy mountains of Santa Martha.</i> It is believed to be 3000 toises high. | <i>Chain of the shore of Venezuela,</i> 80 t. lower than the Scandinavian Alps, 1350 toises. |
| <i>Volcanic Andes of Guatemala, and primitive Andes of Oaxaca,</i> from 1700 to 1800 t. | <i>Groupe of the West Indies,</i> 170 toises higher than the mountains of Auvergne, 1140 t. |
| <i>Andes of New Mexico and Upper Louisiana</i> (Rocky Mountains), and further west <i>Maritime Alps of New Albion,</i> 1600 to 1900 t. | <i>Chains of the Alleghanies,</i> of 160 t. higher than the chains of Jura and the gates of Malabar, 1040 t. |

This table * contains the whole system of mountains of the New Continent ; namely : the Andes, the maritime Alps of California or New Albion, and the five groupes of the east. I shall subjoin to the facts I have just stated, an observation no less striking ; in Europe, the *maxima* of secondary systems, which exceed 1500 toises, are found solely on the south of the Alps and Pyrenees, that is, on the south of the principal ridge of the continent. They are placed on the side where that ridge draws nearest the shore, and where the Mediterranean has not overwhelmed the land. On the north

* In order to justify the correctness of the comparisons furnished in this table, we shall mention the following heights : Mont Mezin (Cevennes) 1027 toises ; the Puy de Sancy, vulgarly called the Puy de la Croix, summit of Mount Dore in Auvergne, 972 t. ; the Reculet (Jura), according to the last survey of M. Roger, officer of engineers, 880 t. ; Mount Taddiandamalla in the Gates of Malabar, according to the operations of Colonel Lambton, 887 t. ; the White Mountains of New Hampshire, in the northern part of the Alleghanies, rise to 1040 t. ; but towards the south, a few instances in Virginia, the Peaks of Otter (Blue Ridge), are considered as very lofty ; according to Morse, they are 486 t. ; according to Tanner, 667. The mean height of the *line of elevation* of the Alleghanies is nearly 450 t., consequently at least 200 t. less than the mean height of the Jura. The table to which this note refers, furnishes the comparisons only of the loftiest summits, the maxima of their ridges, which we must take care not to confound with their *mean height*.

of the Alps and Pyrenees, on the contrary, the most elevated secondary systems, the Carpathian and the Scandinavian mountains* do not attain 1300 toises of height. The depression of the line of elevation of the second order is consequently found in Europe as well as in America, on the side where the *principal ridge is farthest removed from the shore*. If we did not fear to subject great phenomena to too small a scale, we might compare the difference of the height of the Alps and the mountains of eastern America, with the difference of height observed between the Alps or the Pyrenees, and the mountains Dore, Jura, the Vosges, or the Schwarzwald.

We have just seen that the causes which heaved up the oxidated crust of the globe in ridges, or in groupes of mountains, have not acted very powerfully in the vast extent of country that stretches from the eastern part of the Andes, towards the ancient continent; that depression and that continuity of plains are geologic facts, so much the more remarkable, as they extend no where else on more different

* The Lomnitzer Spiz of the Carpathian, is, according to M. Wahlenberg, 1245 toises; the Sneehaetta, in the chain of Dovrefield in Norway (the highest summit of the whole ancient continent, on the north of the parallel of 55°), is 1270 toises above the level of the sea.

latitudes. The five systems of mountains of eastern America, of which we have indicated the limits, divide that part of the continent into an equal number of basins, of which only, that of the Caribbean sea has remained submerged. From north to south, from the polar circle towards the strait of Magellan, we see in succession :

α. THE BASIN OF THE MISSISSIPI AND OF CANADA.

An able geologist, Mr. Edwin James, has shewn recently* that this basin is comprehended between the Andes of New Mexico, or the Upper Louisiana, and the chains of the Alleghanies which stretch towards the north in crossing the rapids of Quebec. It being quite as open towards the north as towards the south, it may be designated by the collective name of the basin of the Mississippi, the Missouri, the river Saint Lawrence, the great lakes of Canada, the Mackenzie river, the Saskatchewan, and the coast of Hudson's Bay. The tributary streams of the lakes and those of the Mississippi are not separated by a chain of mountains running from east to west, as traced on several maps; the line of partition of the waters is marked by a slight ridge, a rising of the two counter-

* *Long, Expedition*, Vol. i, p. 7; Vol. ii, p. 380, 428.

slopes in the plain *. No chain exists between the sources of the Missouri and the Assiniboni, which is a branch of the Red River and of Hudson's Bay. The surface of these plains, almost all in savannahs, between the polar sea and the gulph of Mexico, is more than 270,000 square marine leagues, nearly equal to the *area* of all Europe. On the north of the parallel of 42° , the general slope of the land runs towards the east; on the south of the parallel, it inclines towards the south. To form a precise idea how little abrupt are these slopes †, we must recollect that the level of Lake Superior is 100 toises; that of Lake Erie, 88 t.; and that of Lake Ontario, 36 t. above the level of the waters of the Ocean. The plains around Cincinnati (lat. $39^{\circ} 6'$), are scarcely, according to Mr. Drake, 80 t. of absolute height. To-

* See above, Vol. iv, p. 151.

† Tanner, *American Atlas*, 1823, p. 9. Amos Eaton and Stephen van Rensselaer, *Geolog. Survey of Erie Canal*, 1824, p. 151. In the United States, the slope of the Missouri is estimated from its confluence with the river Platte (lat. $41^{\circ} 3' 13''$) as far as its mouth in the Mississippi, (lat. $38^{\circ} 51' 39''$, long. $92^{\circ} 22' 55''$) from 3 to 4 miles an hour, or $14\frac{1}{2}$ inches of French feet by the English mile of 827 toises; the slope of the Mississippi, from its confluence with the Missouri to the sea, is estimated at $10\frac{1}{4}$ inches. (Long, *Exped.* Vol. ii, Append. p. xxvi, xxviii; and above, *Per. Nar.* Vol. iv, p. 246.)

wards the west, between the Mounts Ozark and the foot of the Andes of Upper Louisiana (*Rocky Mountains*, lat. 35° — 38°), the basin of the Mississippi is considerably raised in the vast desert described by Mr. Nuttall. It presents a series of small table-lands, succeeding each other by degrees, and of which the most westerly (the nearest the Rocky Mountains, between the Arkansas and the Padouca), rises more than 450 toises. Major Long measured a base to determine the position and the height of James Peak. In the great basin of the Mississippi, the line that separates the forests and the savannahs runs, not, as may be supposed, in the manner of a parallel, but like the Atlantic coast, and the Alleghany mountains themselves, from N.E. to S.W., from Pittsburg towards Saint Louis, and the Red River of Natchitoches, so that the northern part only of the state of the Illinois is covered with gramina*. This line of demarcation is not only interesting for

* Manuscript Observations of Mr. Gallatin. Beyond, that is, on the west of the savannahs or fields of the Missouri, we again find forests at the foot of the Rocky Mountains. Between this chain and that of the coast (the Maritime Alps of New Albion), there are plains in which wood is scarce; but in passing the Maritime Alps, the forests recommence, and the country as far as the mouth of the Rio Columbia, presents all the advantages of Tennessee and Kentucky.

the geography of plants, but exerts, as we have said above, a great influence on the feeble culture and population north-west of the Lower Mississippi. In the United States, the savannah countries are more slowly *colonized*; and even the tribes of independent Indians, are forced by the rigour of the climate to pass the winter along the rivers, where poplars and willows are found. The basins of the Mississippi, of the lakes of Canada and the Saint Lawrence, are the largest of America; and although the total population does not rise at present beyond three millions*, it may be considered as that in which, between the 29° and 45° of latitude, (long. 74°—94°), civilization has made the greatest progress. It may even be said that in the other basins (of the Oronoko, the Amazon, and Buenos Ayres), agricultural life scarcely exists; it begins on a small number of points only, to replace pastoral life, and that of fishing and hunting nations. The plains between the Alleghanies and the Andes of Upper Louisiana are of so vast an extent, that similar to the Pampas† of Choco and

* Vol. vi, p. 142.

† The Palm-trees extend towards the south, in the Pampas of Buenos Ayres, and in the Cisplatine province, to 34° and 35°. (*Auguste de Saint Hilaire, Aperçu d'un Voyage au Bresil*, p. 60.)

Buenos Ayres, Bambousacees (*Ludolfia*, *Miega*) and Palm-trees grow at one of their extremities, while the other during a great part of the year is covered with ice and snow.

β. THE BASIN OF THE GULPH OF MEXICO, AND OF THE CARIBBEAN SEA. This is a continuation of the basin of the Mississippi, Louisiana, and Hudson's Bay. It may be asserted, that all the low lands on the coast of Venezuela which are preserved on the north of the chain of the shore, and of the *Sierra Nevada de Merida*, belong to the submerged part of this basin. If I treat here separately concerning the basin of the Caribbean Sea, it is to avoid confounding what, in the present state of the globe, is above and below the surface of the waters. I have already shewn in another place, how much the recent coincidence of the epochs of earthquakes observed at Caraccas, and on the banks of the Mississippi, the Arkansas and the Ohio *, justifies the geologic views which regard as one basin the plains bounded on the south, by the Cordillera of the shore of Venezuela; on the east, by the Alleghanies and the series of the volcanoes of the West Indies; and on the west, by the Rocky Mountains (Mexican

* Vol. iv, p. 9.

Andes) and by the series of the volcanoes of Guatemala. The basin of the West Indies forms, as we have already observed, a *Mediterranean with several issues*, the influence of which on the political destinies of the New Continent depends at the same time on its central position and the great fertility of its islands. The issues of the basin, of which the four largest * are 75 miles broad, are all on the eastern side, open towards Europe, and agitated by the current of the tropics. In the same manner as we recognize in our Mediterranean, the vestiges of three ancient basins by the proximity of Rhodes, Scarpento, Candia, and Cerigo, as well as by that of Cape Sorello of Sicily, the island of Pantelaria and Cape Bon of Africa; in the same manner the basin of the West Indies, which surpasses the Mediterranean in extent, seems to present the remains of ancient dykes that join † Cape Catoche of Yucutan, to Cape

* Between Tabago and Grenada; the isle Saint Martin and the Virgin Isles, Porto Rico and Saint Domingo, and between the Small Bank of Bahama and Cape Cañaveral of Florida.

† I do not pretend that this hypothesis of the rupture and the ancient continuity of lands can be extended to the eastern foot of the basin of the West Indies, that is, to the series of volcanic islands in a line from Trinidad to Portorico. See the information I gave, Vol. iv, p. 36, &c.

Saint Antoine of the island of Cuba; and that island Cape Tiburon of Saint Domingo, Jamaica, the Bank of La Vibora, and the rock of Serranilla to Cape Gracias a Dios on the coast of the Mosquitos. From this disposition of the most prominent islands and capes of the continent, there results a division into three partial basins. The most northerly has long been marked by a particular denomination, that of the *Gulph of Mexico*; the intermediary or central basin may be called the *Sea of Honduras*, on account of the gulph of that name which makes a part of it; and the southern basin, comprehended between the Caribbean islands and the coast of Venezuela, the isthmus of Panama, and the country of the Mosquitos Indians, would form the Caribbean Sea*. The modern volcanic rocks distributed on the two opposite banks of the basin of the West Indies on the east and west, but not on the north and south, is also a phenomenon well worthy of attention. In the Caribbean islands, a groupe of volcanoes, partly extinguished and partly burning,

* This denomination is so much the more exact when appropriated to the southern part of the basin of the West Indies, that the people of Carib race were disseminated on the neighbouring continent and in the Archipelago, from the Caribana of Darien as far as the Virgins. See above, Vol. vi, p. 22 and 329.

stretches from 12° to 18° ; and in the Cordilleras of Guatemala and Mexico from 9° to $19\frac{1}{2}^{\circ}$ of latitude. I saw at the north-west extremity of the basin of the West Indies the secondary formations dip towards the south-east; along the coast of Venezuela, rocks of gneiss and primitive mica-slate dip towards the north-west. The basalts, amygdaloides, and trachytes, which are often surmounted by tertiary lime-stones, appear only towards the eastern and western banks.

8. **THE BASIN OF THE LOWER OROONOKO, OR THE PLAINS OF VENEZUELA.** This basin, like the plains of Lombardy, is open to the east. Its limits are the chain of the shore of Venezuela on the north; the eastern Cordillera of New Grenada on the west; and the Sierra Parime on the south; but as the latter groupe extends on the west, only to the meridian of the cataracts of Maypures (long. $70^{\circ} 37'$), there remains an opening or land-strait, running from north to south, by which the Llanos of Venezuela communicate with the basin of the Amazon and the Rio Negro. We distinguish between the *basin of the Lower Oroonoko properly so called* (on the north of that river and the Rio Apure), and the *plains of Meta and Guaviare*. The latter

fill the space between the mountains of Parime and New Grenada. The two parts of this basin have an opposite direction; but being alike covered with gramina, they are usually comprehended in the country under the same denomination. Those Llanos (*steppes, savannahs, or prairies*) extend in the form of an arch from the mouth of the Oroonoko, by San Fernando de Apure, to the confluence of the Rio Caguan with the Jupura, consequently on a length of more than 360 leagues.

1.) *Part of the basin of Venezuela running from east to west.* The general slope is towards the east, and the mean height from 40 to 50 toises. The western bank of that great *sea of verdure (mar de yerbas)* is formed by a groupe of mountains, several of which equal or surpass in height the Peak of Teneriffe and Mont Blanc. Of this number are the Paramos del Almorzadero, Cacota, Laura, Porquera, Mucuchies, Timotes, and Las Rosas. The northern and southern banks are generally less than 500 or 600 toises high. I have given elsewhere an ample description of the soil of the *Llanos* (Vol. iii, p. 285, 349; Vol. iv, p. 293, 300, 313, 317, 330, 394; Vol. v, p. 670; Vol. vi, p. 4, 17, 43, 73.) It is remarked with some surprise, that the *maximum*

of the depression of the basin is not in its center, but on its southern limit, at the Sierra Parime, along which runs the *thalweg* of the Oroonoko. It is only between the meridians of Cape Codera and Cumana, where a great part of the Cordillera of the shore of Venezuela has been destroyed, that the waters of the *Llanos* (the Rio Unare and the Rio Neveri) reach the northern coast. The ridge of partition of this basin is formed by small table-lands, known by the names of Mesas d'Amara, Guanipa, and Jonoro. (Vol. iv, p. 30; Vol. vi, p. 48.) In the eastern part, between the meridians 63° and 66° , the plains or savannahs pass, towards the south, beyond the bed of the Oroonoko and the Imataca, and form (in approaching the Cumuni and the Essequibo,) a kind of gulph along the Sierra Pacaraina (Vol. v, p. 760; Vol. vi, p. 504).

2.) *Part of the basin of Venezuela running from south to north.* The great breadth of this zone of savannahs, of from 100 to 120 leagues, renders the denomination of *land-strait* somewhat improper, at least if it be not geognostically applied to every communication of basins bounded by high Cordilleras. Perhaps this denomination rather belongs to that part where the groupe

of almost unknown mountains is placed, that surround the sources of the Rio Negro. (Vol. vi, p. 512). In the basin comprehended between the eastern declivity of the Andes of New Grenada, and the western part of the Sierra Parime, the savannahs, as we have observed above, stretch far beyond the equator, but their extent does not determine the southern limits of the basin we here examine. The latter are fixed by a ridge that divides the waters between the Oroonoko and the Rio Negro, a tributary stream of the Amazon. The rising of a counterslope almost imperceptible to the eye, forms a ridge that seems to join the eastern Cordillera of the Andes to the groupe of Parime *. This ridge runs from Ceja (lat. $1^{\circ} 45'$), or the eastern slope of the Andes of Timana †, between the sources of the Guayavero and the Rio Caguan ‡, towards the isthmus that separates the Tuamini from Pimichin §. In the *Llanos*, consequently, it follows the parallels of $20^{\circ} 30'$ and $2^{\circ} 45'$. It is remarkable, that we find the *divortia aquarum* more to the west, on

* Vol. vi, p. 397.

† See my Map of Magdalena (*Geogr. Atlas*, pl. xxiv).

‡ The former is a tributary stream of the Guaviare, the latter of Yupura.

§ Isthmus of Javita, or portage of Pimichin (Vol. v, p. 259, 260, 279, *Geogr. Atlas*, pl. xvi).

the back of the Andes, in the knot of mountains containing the sources of the Magdalena, at a height of 900 toises above the level of the *Llanos*, between the Caribbean Sea and the Pacific Ocean *, almost in the same latitude ($1^{\circ} 45' - 2^{\circ} 20'$). From the isthmus of Javita towards the east, the *line of the partition of the water* is formed by the mountains of the groupe of Parime ; it first rises a little on the north-east towards the sources of the Oroonoko (lat. $3^{\circ} 45'$?) and the chain of Pacaraina † (lat. $4^{\circ} 4' - 4^{\circ} 12'$) ; afterwards, during a course of 80 leagues, between the portage of the Anocapra ‡ and the banks of the Rupunuri, runs very regularly from west to east ; and finally, beyond the meridian $61^{\circ} 50'$, again deviates towards lower latitudes, passing between the northern sources of the Rio Suriname, the Maroni, and the Oyapok, and the southern sources of Rio Trombetas, Curupatuba, and Paru (lat. $2^{\circ} - 1^{\circ} 50'$). These indications suffice to prove that this *first line of partition of the water* of South America (that of the northern hemisphere) traverses the whole continent between the parallels of 2° and 4° . The Cassiquiare only has cut its

* Vol. v, p. 325, 326 ; Vol. vi, p. 439.

† Vol. vi, p. 520.

‡ Road from Rio Borneo to Rio Carony.

way across the ridge we have just described. The hydraulic system of the Oroonoko displays the singular phenomenon of a bifurcation where the limit of two basins (of the Oroonoko and the Rio Negro) traverses the bed of the principal recipient. In that part of the basin of the Oroonoko which lies from south to north, as well as in that lying from west to east, the *maxima* of the depression are found at the foot of the Sierra Parime, we may even say on its outline.

8. THE BASIN OF THE RIO NEGRO AND THE AMAZON. This is the central and largest basin of South America. It is exposed to frequent equatorial rains, and the hot and humid climate develops a force of vegetation to which nothing in the two continents can be compared. The central basin, bounded on the north by the groupe of Parime, and on the south by the mountains of Brazil, is almost entirely covered by thick forests, while the two basins placed at the two extremities of the continent (the *Llanos* of Venezuela and the Lower Oroonoko, and the *Pampas* of Buenos Ayres or the Rio de la Plata) are savannahs or *prairies*, plains destitute of trees and covered with gramina. This symmetric distribution of savannahs bounded by impenetrable forests, must be connected with

physical revolutions which have acted* at once on great surfaces.

1.) *Part of the basin of the Amazon, running from west to east, between 2° north and 12° south, is 880 leagues in length. The western shore of this basin is formed by the chain of the Andes, from the knot of the mountains of Huanuco to that of the sources of the Magdalena. It is enlarged by the counterforts of the Rio Beni †, rich in 'gem-salt, and composed of several ranges of hills (lat. 8° 11' south) that advance in the plains on the eastern bank of the Paro. These hills are transformed on our maps into Upper Cordilleras and Andes of Cuchao ‡. Towards the*

* Vol. iv, 336 ; Vol. vi, p. 61, &c. *Martius, Phys. der Pflanzen von Bras.*, p. 13.

† Vol. vi, p. 442. The real name of this great river, respecting the course of which geographers have been so long divided, is *Uchaparú*, probably *water (para) of Ucha* ; *Beni* also signifies *river, water* ; for the language of the Maypures has multiplied analogies with that of the Moxos (Vol. v, p. 148) ; and *veni (oueni)* signifies *water* in Maypure, as *una* in Moxo. Perhaps the river retained the name of Maypure, when the Indians who spoke that language had emigrated to the north, towards the banks of the Oroonoko.

‡ *The Andes of Cuchao*, placed in Arrowsmith's map at 10½°-12° north of the fabulous lake of Rogagualo, are nothing more than the mountains of Cuchao, placed by La Cruz, lat. 13°, south-west of that lake. This geographer by

north, the basin of the Amazon, of which the *area* (244,000 square leagues) is only a sixth less than the *area* of all Europe, rises in a gentle slope towards the Sierra Parime. At 68° of west longitude the elevated part of this Sierra terminates at 3½° of north latitude. The groupe of monticules that surround the source of the Rio Negro, the Inirida and the Xie (lat. 2°) the scattered rocks between the Atabapo and the Cassiquiare, appear like groupes of islands and rocks in the middle of the plain. A part of those rocks is covered with signs or symbolical sculpture. Nations, very different from those who now inhabit the banks of the Cassiquiare, penetrated into the savannahs; and the zone of *painted rocks*, extending more than 150 leagues in breadth, presents traces of ancient civilization. On the east of the sporadic groupes of rocks (between the meridian of the bifurcation of the Oroonoko and that of the confluence of the Essequibo with the Rupunuri), the lofty mountains of Parime commence only at 3° of latitude;

a strange error, has covered plains with mountains of which they are entirely destitute. He forgot that in the colonies, *monte* signifies almost exclusively a forest, and he has traced chains of mountains wherever he has written *montes de cacao*, as if the cacao-tree did not belong to the hottest region of the plains.

where the plains of the Amazon terminate. The vast gulph which they seem to form in the upper part of the basin of the Rio Branco, and the windings of the southern slope of the Sierra Parime, have been discussed above*. The limits of the plains of the Amazon are still more unknown towards the south than towards the north. The mountains that exceed 400 toises do not appear to extend in Brazil on the north of the parallel of 14° to 15° of south latitude, and west of the meridian of 52° ; but it is not known how far the *mountainous country* is prolonged, if we may call by that name a territory bristled with hills of one hundred or two hundred toises high. Between the Rio das Vertentes and the Rio de Tres Barras (tributary streams of the Araguay and the Topayos), several ridges of the *Mounts Parecis* run towards the north. On the right bank of the Topayos, a series of monticules advance (according to manuscript maps recently framed at the hydrographic Depôt of Rio Janeiro) as far as the parallel of 5° south latitude, to the fall (*cachoeira*) of Maracana; while further west, in the Rio Madeira, of which the course is nearly parallel with that of the Topayos, the rapids and cataracts (of which seventeen are rec-

* Vol. vi, p. 520, &c.

koned between Guayramerin* and the famous Salto of Theotonio†) indicate no rocky ridges beyond the parallel of 8°. The principal depression of the basin of which we have just examined the outline, is not found near one of its banks, as in the basin of the Lower Oronoko, but at the center, where the great recipient of the Amazon forms a longitudinal furrow inclined from west to east, under an angle of at least 25 seconds‡. The barometric measures which I made at Javita on the banks of the Tuamini, at Vasiva on the banks of the Cassiquiare, and at the cataract of Rentema, in the Upper Maragnon, seem to prove that the rising of the plains of the Amazon towards the north (at the foot of the Sierra Parime), is 150 toises, and, towards the west (at the foot of the Cordillera of the Andes of Loxa), is 190 toises, above the level of the Ocean§. It is to be hoped, that when steam-boats go up the Amazon from Grand Para as far as Pongo

* Above the confluence of the Madeira and Mamorè, which a Brazilian journal, justly esteemed (*Patriota*, 1813, p. 288), places in 10° 22' 30" of latitude, while it marks the confluence of the Madeira with the Guaporè, at 11° 54' 46".

† Above the confluence of the Madeira and the Jamary.

‡ See above, Vol. vi, p. 395, note.

§ Vol. v, p. 251, 347, 550, 551, and *Rec. d'Obs. Astr.* Vol. i. p. 315.

de Manseriche, in the province of Maynas, the barometric measurement of the course of this river, which is the *thalweg* of a plain fifteen times the extent of the whole of France, will not be neglected.

2.) *Part of the basin of the Amazon stretching from south to north.* This is the zone or land strait by which, between 12° and 20° of south latitude, the plains of the Amazon communicate with the *Pampas* of Buenos Ayres. The western bank of this zone is formed by the Andes, between the knot of Porco and Potosi, and that of Huanuco and Pasco. Part of the *counter-forts of the Rio Beni*, which is but a widening of the Cordilleras of Apolobamba and Cuzco*, and the whole promontory of Cochabamba†, advance towards the east in the plains of the Amazon. The prolongation of this promontory has given rise to the idea that the Andes are linked with a series of hills which the *Serras dos Parecis*‡, the Serra Melgueira, and the pretended Cordillera of San Fernando, throw out towards the west. The almost unknown part of the frontiers of Brazil and Upper

* Vol. vi, p. 432.

† Vol. vi, p. 419.

‡ Vol. vi, p. 538.

Peru merit the attention of travellers. It appears from the most recent notions we can collect, that the ancient mission of San Jose of Chiquitos (nearly lat. 17° ; long. $67^{\circ} 10'$, supposing Santa Cruz de la Sierra, lat. $17^{\circ} 25'$; long. $66^{\circ} 47'$), is situated in the plains, and that the mountains of the counter-fort of Cochabamba terminate between the Guapaix (Rio de Mizque) and the Parapiti, which lower down takes the names of Rio San Miguel and Rio Sara. The savannahs of the province of Chiquitos communicate on the north with those of Moxos, and on the south with those of Chaco* ; but, as we have observed above, a ridge or line of partition of the water is formed, by the intersection of two plains slightly sloped, which takes its origin on the north of La Plata (Chuquisaca) between the sources of the Guapaix and the Cachimayo, (a tributary stream of the Pilcomayo), and ascends from the parallel of 20° to that of $15\frac{1}{2}^{\circ}$ of south latitude, consequently on the north-east, towards the isthmus of Villabella†. From this point, one of the most important of the whole hydrography of America, we can follow the line of the partition of the water to

* *Cárta de las Misiones de los Moxos de la Compañia de Jesus de el Perú*, 1709.

† Between the tributary stream of the Paraguay and the Madeira, Vol. vi, p. 535.

the Cordillera of the shore (*Serra do Mar*). It is seen winding (lat. 17° - 20°) between the northern sources of the Araguay, the Maranhao or Tocantines, and the Rio San Francisco, and the southern sources of the Parana. This *second line of partition*, which enters into the groupe of the mountains of Brazil, on the frontier of the Capitainerie of Goyaz, separates the flowings of the basin of the Amazon from those of the Rio de la Plata, and corresponds, south of the equator, with the line we have indicated in the northern hemisphere (lat. 2° - 4°), on the limits of the basins of the Amazon and the Lower Oronoko *.

If the plains of the Amazon (taking that denomination in the geognostic sense we have given it) are distinguished in general from the *Llanos* of Venezuela and the *Pampas* of Buenos Ayres, by the extent and thickness of their forests, we are so much the more struck by the continuity of the savannahs in that part running from south to north. It would seem as if this *sea of verdure* stretched forth an arm from the basin of Buenos Ayres, by the *Llanos* of Tucuman, Manso, Chuco, the Chiquitos, and the Moxos, to the *Pampas del Sacramento* †, and the

* Vol. vi, p. 577.

† This Pampas, which Sobreviela first made known, bears

savannahs of Napo, Guaviare, Meta, and Apure *. This arm crosses, between 7° and 3° of south latitude, the basin of the forests of the Amazon, and the absence of trees on so great an extent of territory (the preponderance which the small monocotyledon plants have acquired) is a phenomenon of the geography of plants which belongs perhaps to the action of ancient pelagic currents, or other partial revolutions of our planet.

ε. PLAINS OF THE RIO DE LA PLATA, AND OF PATAGONIA, from the south-west slope of the groupe of the mountains of Brazil, to the strait of Magellan, from 20° to 53° of latitude. These plains correspond with those of the Mississippi and of Canada in the northern hemisphere. If one of their extremities draws less nigh the polar regions, the other enters so much further into the region of palm trees.

also the name of *Pajonal* (plain which produces *straw*), between the Rio Paro, a tributary stream of the Ucayali and the banks of the Huallaga.

* I have named the plains covered with gramina, in the order in which they succeed each other from south to north, from the 30° of south, to the 9° of north-latitude. The savannahs between the Rio Vermejo and the Pilcomayo, (south lat. 22°-25½°) are called *Llanos de Manso*, after the name of a Spaniard who made the first essays of cultivation in those desert countries. (*Brackenridge*, Vol. 2, p. 17).

That part of this vast basin extending from the eastern coast towards the Rio Paraguay, (that is the Capitania of Rio Grande, west of the island Saint Catherine, the Cisplatine province of Paraguay properly so called, between the Parana and the Rio Paraguay) does not present a surface so perfectly smooth as the part situated on the west and south-east of the Rio de la Plata, and which has been known for ages by the name of Pampas, derived from the Peruvian or Quichua language*. Geognostically speaking, these two regions of east and west form only one basin, bounded on the east by the Sierra de Villarica or do Espinhazo, which loses itself in the Capitania of Saint Paul, towards the parallel of 24° ; issuing on the north-east by the monticules†,

* *Hatan Pampa* signifies in that language, a great plain. We find the word *Pampa* also in *Riobamba* and *Guallabamba*; the Spaniards, in order to soften the geographical names, change the *p* into *b*.

† On the south of the Villa of Cuyaba, or rather on the south of the Rio Mbotetey (Emboteteu or Mondego), a mountainous country stretches towards the south, known by the pompous names of *Cordilleras* of Amambay, of San Jose, and of Maracajou. According to the fine manuscript map of the ancient viceroyalty of Rio de la Plata (by Don Miguel de Lastarria, 1804), of which I owe the communication to the kindness of M. Malte-Brun, the whole northern part of Paraguay, between the mission of Curuguati (lat. $24\frac{1}{2}^{\circ}$) and the rivers Mbotetey and Monice (Yaguari) is full of hills.

from the Serra da Canastra and the Campos Parecis towards the province of Paraguay; on the west, by the Andes of Upper Peru and Chili; and on the north-west, by the ridge of the partition of the waters which runs from the counter-fort of Santa Cruz de la Sierra, across the plains of the Chiquitos, towards the Serras of Albuquerque (lat. $19^{\circ} 20'$) and San Fernando. That part only of this basin lying on the west of the Rio Paraguay, and which is entirely covered with gramina (thick forests extend towards Parana, and the sources of the Uruguay), is 70,000 square leagues. This surface of the *Pampas* or *Llanos* of Manse, Tucuman, Buenos Ayres, and eastern Patagonia, exceeds consequently four times the surface of the whole of France. The Andes of Chili narrow the *Pampas* by the two counterforts of Salta and Cordova*: the latter promontory, of which we know with precision the extent by the astronomical

Geographers also figure a chain of mountains between 28° and $34\frac{1}{2}^{\circ}$ of latitude, in the province of the Missions and the Cisplatine] province of Brazil, a chain supposed to separate the waters of the Uruguay from those of the eastern coast; but these Cordilleras are probably not 200 toises high. In comparing the maps of d'Anville, Varela, Dobrizhoffer, and Azara, we perceive that with the progress of geography the mountains of those countries gradually disappear.

* Vol. vi, p. 418.

observations of M.M. Espinosa and Bauza *, forms so projecting a point, that there remains (lat. 31° - 32°) a plain only 45 leagues broad between the eastern extremity of the Sierra de Cordova and the right bank of the river Paraguay, stretching in the direction of a meridian, from the town of Nueva Coimbra to Rosario, below Santa Fe. Far beyond the southern frontiers of the ancient viceroyalty of Buenos Ayres, between the Rio Colorado and the Rio Negro (lat. 38° - 39°) groupes of mountains seem to rise in the form of islands, in the middle of a muriatiferous plain. A tribe of Indians of the south † (*Tehuellet*), have there long borne

* The officers of the Spanish marine quitted the expedition of Malaspina at Lima to rejoin it at Buenos Ayres. They determined the latitude and longitude of Mendoza (lat. $32^{\circ} 52'$; long. $71^{\circ} 23'$) and S. Luis de la Punta (lat. $33^{\circ} 18'$; long. $68^{\circ} 4'$). *Memorias de los Navegantes*, Vol. i, Appendix, p. 181). We find the town of Cordova, according to those positions, to be lat. $31^{\circ} 22'$; long. $66^{\circ} 17'$; admitting with M. Bauza, according to the *Map of the southern Ocean comprehended between Cape Horn and the Cape of Good Hope*, (Madrid, 1804,) the town of Cordova to be $1^{\circ} 47'$ the east of San Luis de la Punta, La Cruz, and Arrow-smith supposed this distance to be $3^{\circ} 20'$ and $3^{\circ} 4'$. M. Bauza, who has visited that country, admits the difference of longitude of Cordova and Santa Fe to be 3° , while Arrow-smith makes $2^{\circ} 36'$. Observations are wanting between Tucuman, Asuncion, and Santa Fe.

† *Het*, man; *tehuel*, noon.

the characteristic name of *men of the mountains* (*Callilehet*) or *Serranos*. From the parallel of the mouth of the Rio Negro to that of Cabo Blanco (lat. 41° — 47°), scattered mountains on the eastern Patagonia coast denote more considerable inequalities in the inlands. All that part however of the strait of Magellan, from the Cape of Virgins to the North Cape, on a breadth of more than 30 leagues, is surrounded by savannahs or Pampas, and the Andes of western Patagonia only begin to rise near the latter cape, exerting a marked influence on the direction of that part of the strait nearest the South Sea, and going from S. E. to N. W.

If we have given the plains or great basins of South America, the names of the rivers that flow in their longitudinal furrows, we have not meant by so doing to compare them to simple vallies. In the plains of the Lower Oroonoko and the Amazon, all the lines of the declivity reach no doubt a principal recipient, and the tributaries of tributary streams, that is the *basins of different orders*, penetrate far into the groupe of the mountains. The upper part or high vallies of the tributary streams are considered in a *geological table*, as belonging to the mountainous region of the country, and placed beyond the plains of the Lower Oroo-

noko and the Amazon. The views of the geologist are not identical with those of hydrography. In the basin which we have called that of the Rio de la Plata and Patagonia, the waters that follow the lines of the greatest declivities have many issues. The same basin contains several vallies of rivers; and when we examine nearly the polyedric surface of the *Pampas* and the portion of their waters which, like the waters of the steppes of Asia *, do not go to the sea, we conceive that these plains are divided by small ridges or *lines of elevation*, and have alternating slopes †, inclined, with respect to the horizon, in opposite directions. In order to point out more clearly the difference between geological and hydrographic views, and prove that in the former, abstracting the course of the waters which meet in one recipient, we obtain a far more general point of view, I shall here again recur to the *hydrographic basin* of the Oroonoko. That immense river rises on the southern slope of the Sierra Parime; it is bounded by plains on the left bank, from the Cassiquiare to the mouth of the Atabapo, and flows in a basin which *geologically*

* The German geographers mark by the name of *rivers of the steppes* (*steppenflüsse*) every system of running waters which has its *maximum* of depression in an interior lake. See above, Vol. iv, p. 149.

* *Journal de l'Ecole polytechnique*, Vol. vii, p. 265.

speaking, according to one great division of the surface of South America in those basins, we have called the basin of the Rio Negro and the Amazon. The low regions, which are bounded by the southern and northern declivities of the mountains of Parime and Brazil, and which the geologist ought to mark by one name, contain, according to the no less precise language of hydrography, two basins of rivers, those of the Upper Oroonoko and the Amazon, separated by a ridge (indication of alternating slopes), that runs from Javita towards Esmeralda. From these considerations it results, that a *geological basin* (*sit venia verbo*) may have several recipients, several emissaries, divided by small ridges almost imperceptible, and may contain at the same time the waters that go to the sea by different furrows independent of each other, and the systems of *inland rivers* flowing into lakes more or less charged with saline matter. A basin of a river, or *hydrographic basin*, has but one recipient, one emissary; if, by a bifurcation, it gives a part of its waters to another hydrographic basin, it is because the bed of the river, or the principal recipient, draws so near the banks of the basin or the ridge of partition that the ridge crosses it in part.

The distribution of the inequalities of the surface of the globe does not display any limits strongly marked between the mountainous coun-

try and the low regions, or geologic basins. Even where the real chains of mountains rise like rocky dykes issuing from a crevice, *counter-forts* that are more or less considerable, seem to indicate their lateral heaving-up. While I recognize the difficulty of well circumscribing the groupes of mountains and the basins or continued plains, I have attempted to calculate their surfaces according to the statements contained in the preceding sheets.

SOUTH AMERICA.

I. MOUNTAINOUS PART :

| | Square Marine Leagues. |
|---|---------------------------|
| Andes | 58,900 |
| Chain of the shore of Venezuela | 1,900 |
| Sierra Nevada de Merida | 200 |
| Groupe of Parime | 25,800 |
| System of the mountains of Brazil | 27,600 |
| | <hr/> 114,400 |

II. PLAINS :

| | |
|--|---------------|
| Llanos of Lower Oroonoko, Meta and Guaviare | 29,000 |
| Plains of the Amazon | 260,400 |
| Pampas of Rio de la Plata, and Patagonia | 135,200 |
| Plains between the eastern chain of the Andes of Cundinamarca and the chain of Choco | 12,300 |
| Plains of the shore, on the west of the Andes | 20,000 |
| | <hr/> 456,900 |

The whole surface of South America is 571,300 square leagues (20 to a degree), and the relation of the mountainous country to the region of the plains is as 1 : 3,9. The latter region, on the east of the Andes, is more than 424,600 square leagues, the half of which consists of savannahs, that is, it is covered with gramina.

SECTION II.

General partition of lands.—Direction and inclination of the layers.—Relative height of the formations above the level of the Ocean.

We have examined in the preceding section, the inequalities of the surface of the soil, that is, the general *structure* of the mountains, and the form of the basins left between those mountains variously grouped together. These mountains are sometimes *longitudinal*, by narrow bands or chains, similar to the veins that preserve their tendency at great distances (Andes, mountains of the shore of Venezuela, Serra do Mar of Brazil, Alleghanies of the United States); sometimes they are in masses with irregular forms, in which the heavings-up seem to take place as on a labyrinth of crevices or a *heap* of veins (Sierra Parime, Serra das Vertentes). These modes of formations are linked with an

hypothesis of geognosy *, which has at least the advantage of being founded on facts observed on historic lines, and which strongly characterize the *chains* and *groupes* of mountains. Considerations on the aspect of a country are independent of those which indicate the nature of the soil, the heterogeneity of matter, the superposition of the rocks, and the direction and inclination of the beds; the latter will be stated in the second and third sections of this memoir. With respect to the *relief* and the connection of the inequalities of the soil, the half of the lunar globe is now, perhaps, better known than the half of the terrestrial globe, and the *geology of formations*, for ever inaccessible to physical astronomy, if not devoted to dangerous errors, advances with extreme slowness, even in the countries of Europe nearest to each other.

In taking a general view of the geological constitution of a chain of mountains, we may distinguish *five elements of direction* too often confounded in works of geognosy and physical geography. These elements are:—

* See the new and important observations on the origin of the chains of mountains, in a work well fitted to fix the attention of geognosts: *Resultatn der neuesten geogn. Forschungen des Herre Leopold von Buch, zusammenges telle und ubersezt von K. C. von Leonhard*, p. 307, 382, 438, 470, 475, 506.

- α .) The Longitudinal axis of the whole chain.
- β .) The line that divides the waters (*divortia aquarum*).
- γ .) The line of ridges or elevation passing along the maxima of height.
- δ .) The line that separates into horizontal sections, two contiguous formations.
- ϵ .) The line that follows the rents of stratification.

This distinction is so much the more necessary, as there exists probably no chain on the globe that furnishes a perfect parallelism of all these *directing lines*. In the Pyrenees, for instance, α , β , γ do not coincide, but δ and ϵ (that is, the different bands of formations which come *to light* successively, and the direction of the strata) are sensibly parallel to α , or to the direction of the whole chain *. We find so often in the most distant parts of the globe, a perfect parallelism between α and ϵ , that it may be supposed that the causes which determine the direction of the axis (the angle under which that axis cuts the meridians), are generally linked with causes that determine the direction and

* The direction of the longitudinal axis α in the Pyrenees, and that of the formations δ , which appear successively at the surface of the soil, as in long bands, are N. 68° 73° W. Now, as the line of the *maxima* of height γ , is not parallel with the axis α , it results from the fine observations of MM. Palassou, Ramond and Charpentier, that it must necessarily pass by very different formations.

inclination of the strata. This direction of the strata is independent of that of the bands of formations, or their visible limits at the surface of the soil; the lines δ and ϵ sometimes cross each other, even when one of them coincides with α , or with the direction of the longitudinal axis of the whole chain. The *relief* of a country cannot be explained with precision on a map, nor can the most erroneous opinions on the place and superposition of soils be avoided, if we do not seize with clearness the relations of the *directing lines* which we have just mentioned.

In that part of South America which makes the principal object of this memoir, and which is bounded by the river Amazon on the south, and on the west by the meridian of the snowy mountains (*Sierra Nevada*) of Merida, the different bands or zones of formations δ , are sensibly parallel with the longitudinal axis α of the chains of mountains, basins, or interposed plains. It may be said in general that the *granitic zone*, (uniting under that denomination the rocks of granite, gneiss, and mica-slate) follows the direction of the Cordillera of the shore of Venezuela, and belongs exclusively to that Cordillera and the groupe of the mountains of Parime; since it no where pierces the secondary and tertiary soils in the *Llanos* or basin of the Lower Oroonoko. It thence re-

sults, that the same formations do not constitute the region of plains and of mountains.

If we may be permitted to judge of the structure of the whole *Sierra Parime*, from the considerable part which I have examined in 6° of longitude, and 4° of latitude, we may believe it to be entirely composed of gneiss-granite; I saw some beds of green-stone, and amphibolic slate, but neither mica-slate, clay-slate, nor banks of green lime-stone, although many phenomena render the presence of the former of those rocks probable, on the east of the Maypures and in the chain of Pacaraina. The geological formation of the groupe of Parime, is consequently still more simple than that of the Brazilian groupe, in which granites, gneiss, and mica-slate, are covered with thonschiefer, chloritous quartz (Itacolumite), grauwakke, and transition limestone*; but those two groupes have in common, as we have already mentioned, the absence of a real system of secondary rocks; we find in both some fragments only of sand-stone or silicious conglomerate. In the Cordillera of the *shore of Venezuela* †, the granitic formations predominate; but they are wanting towards the east, and especially in the southern chain, where we

* See my Essay on the position of rocks, p. 96, and Eschwege, Geogn. Gemalde, pp. 7, 17, 24.

† On its limits and divisions, see Vol. vi, pp. 485—505.

observe (in the missions of Caripe and around the gulph of Cariaco) a great accumulation of secondary and tertiary calcareous rocks. From the point where the Cordillera of the shore is linked with the Andes of New Grenada (long. $71\frac{1}{2}^{\circ}$), we observe first the granitic mountains of Aroa and San Felipe, between the rivers of Yaracui and Tocuyo *; these granitic formations extend on the east of the two coasts of the basin of the *Vallies of Aragua*, in the northern chain, as far as Cape Codera; and in the southern as far as the mountains (*Altas Savanas*) of Ocumare. After the remarkable interruption of the Cordillera of the shore in the province of Barcelona, the granitic rocks begin to appear in the Island of Marguerita and in the isthmus of Araya, and continue perhaps towards the *Bocas del Drago*; but on the east of the meridian of Cape Codera, the northern chain only is granitic (of micaceous slate); the southern chain (Morro de Nueva Barcelona, Archipelago of the Caraccas islands, Cerro del Bergantin, vicinity of Cumanacoa, Cocollar and Caripe,) is entirely composed of secondary limestone and sandstone.

* Manuscript notes of General Cortes: my own observations begin only in the meridian of Portocabello (long. $70^{\circ} 37'$) and terminate at that of Cerro de Meapire (long. $65^{\circ} 51'$), near Cariaco.

If, in the *granitic soil* which is here a very *complex formation*, we would distinguish mineralogically between the rocks of granite, gneiss, and micaslate, we must recollect that according to my local observations, the granite with large grains, not passing to gneiss, is very rare in this country. It belongs peculiarly to the mountains that bound the basin of the lake of Valencia towards the north; for in the islands of that lake, in the mountains near the town of Cura, and in the whole northern chain, between the meridian of Victoria and Cape Codera, gneiss predominates, sometimes alternating (Silla de Caraccas) with granite, or passing (between Guigue and Villa de Cura, mountain of Chacoa) to micaslate*. The micaslate is the most frequent rock in the peninsula of Araya† and the groupe of Macanao which forms the western part of the island of Marguerita. On the west of Maniquarez, the micaslate of the peninsula of Araya loses by degrees (Cerro de Chuparuparu) its half-metallic lustre; it is charged with carbon and becomes a clayslate (thonschiefer)‡, even an ampelite (alaunschiefer). The beds of granular limestone are most common in the primitive northern chain, and, which is some-

* Vol. iv, p. 273, &c.

† Vol. ii, p. 291.

‡ Vol. vi, p. 101.

what remarkable, they are found in gneiss, and not in micaslate.

We find at the back of this granitic, or rather micaslate-gneiss soil of the southern chain, on the south of the Villa of Cura, a *transition soil*, composed of greenstone, amphibolic serpentine, micaceous limestone, and green and carburated slate*. The most southern limit of this territory is formed by *volcanized rocks*. Between Parapara, Ortiz, and the Cerro de Flores (lat. $9^{\circ} 28' - 9^{\circ} 34'$; long. $70^{\circ} 2' - 70^{\circ} 15'$), phonolithes and amygdaloides are found on the very border of the basin of the *Llanos*, that vast internal sea which heretofore filled the whole space between the Cordilleras of Venezuela and Parime. We shall here remark that, according to the observations of Major Long and Doctor James, trappean formations (bulleuses dolerites and amygdaloides with pyroxene) also border the plains or basin of the Mississippi, towards the west, at the declivity of the Rocky Mountains†. The ancient pyrogenie rocks which I found near Parapara where they rise in mounds with rounded summits, are the more remarkable as no others have been hitherto dis-

* Vol. iv, 279, &c.

† From the sources of the Canadian river to the Rio Colorado de Natchitoches. See Long. *Exped.* Vol. ii, p. 91, 402.

covered in the whole eastern part of South America. The close connection observed in the soil of Parapara, between greenstone, amphibolic serpentine, and amygdaloides containing crystals of pyroxene; the form of the Morros of San Juan, which rise like cylinders above the table-land; the granular texture of their limestone surrounded by trapean rocks, are objects worthy the attention of the geologist, who has studied in the southern Tyrol, the effects produced by the contact of poroxenic porphyrys*.

The *calcareous soil* of the Cordillera of the shore is most frequent, as we have already observed, on the east of Cape Unare, in the southern chain; it extends to the gulph of Paria, opposite the island of Trinidad, where we find gypsum of Guire, containing sulphur. I have been assured that in the northern chain also, in the *Montaña de Paria*, and near Carupana, secondary calcareous formations are found, and that they only begin to appear on

* *Leopold de Buch, Tableau geologique du Tyrol*, p. 17. I learn by very recent letters from M. Boussingault, that these singular Morros de San Juan which furnish a limestone with crystalline grains, and thermal springs, are hollow, and contain immense grottos filled with stalactites, which appear to have been anciently inhabited by the natives,

the east of the ridge * of rock (Cerro de Meapire) which joins the calcareous groupe of Guacharo to the groupe of micaslate of the peninsula of Araya; but I have not had occasion to verify the justness of this observation. The calcareous soil of the southern chain is composed of two formations which appear distinct, the limestone of Cumanacoa and that of Caripe. While I was on the spot, the former appeared to me to have some analogy with the zechstein, or alpine limestone; the latter with jurassic limestone; I even thought that the latter granular gypsum of Guire might be that which belongs in Europe to zechstein, or is placed between zechstein and variegated sandstone. Beds of quartzous sandstone, alternating with slaty clay, cover the limestone of Cumanacoa†, Cerro del Impossible, Turimiquiri, Guarda de San Agustin) and the jurassic limestone‡ in the province of Barcelona (*Aguas calientes*). According to this position, this sandstone may be considered as belonging to the formation of green sandstone, or sandstone with lignites below chalk. But it is little probable if (as I thought I observed at Cocollar) the sandstone forms beds in the alpine limestone, before it is

* Vol. iii, p. 183.

† Vol. iii, p. 10, &c. 23, 163.

‡ Vol. vi, p. 80.

superposed, that the sandstone of the *Impossible*, and the *Aguas calientes*, constitute the same soil. The muriatiferous clay (with petroleum and lamellar gypsum) cover the western part of the peninsula of Araya, opposite the town of Cumana, and at the center of the island of Marguerita. This clay appears placed immediately by micaslate, and covered by the calcareous brechia of tertiary soil. I shall not decide if Araya, rich in disseminated muriate of soda* belongs to the formation of sandstone of the *Impossible*, which from its position may be compared to variegated sandstone (red marl).

Fragments of *tertiary soil* surround indubitably the castle and town of Cumana (Castillo de San Antonio), and they also appear at the southwest extremity of the peninsula of Araya (Cerro de la Vela et del Barigon); at the ridge of Meapire, near Cariaco; at Cabo Blanco, on the west of la Guayra, and on the shore of Portocabello; they are found consequently at the foot of the two slopes of the northern chain of the Cordillera of Venezuela. This tertiary † soil is composed of alternate beds of calcareous aglomerats, compact limestone, marl, and clay, containing selenite, and lamellar gypsum. This

* Vol. iii. p. 94.

† Vol. ii, p. 266—269, 290, 291; Vol. iii, p. 204; Vol. vi, p. 93.

whole system of very new beds appears to me to constitute but one formation, which is found at Cerro de la Papa, near Carthagena, and in the islands of Guadaloupe and Martinico.

Such is the geological distribution of the soils in the mountainous part of Venezuela, in the groupe of Parime, and in the Cordillera of the shore. It remains to characterize the formations of the *Llanos* (or of the basin of the Lower Oroonoko and the Apure); but it is not easy to determine the order of their superposition, because in this region ravines or beds of torrents and deep wells dug by the hands of man are entirely wanting. The formations of the *Llanos* are, 1st. a sandstone or conglomerate, with rounded fragments of quartz, lydian, and keiselschiefer* joined by a ferruginous clayey cement, extremely tenacious, olive brown, sometimes of a vivid red: 2d. a compact limestone, (between Timao and Calabozo) which, by its smooth fracture, and lithographic aspect, approaches the Jura limestone: 3d. alternate beds † of marl and lamellar gypsum (Mesa de San Diego, Ortiz, Cachipo). These three formations appeared to me to succeed each other in the order I have just described, the sand-

* See Humboldt, *Essai geognostique*, p. 219, and above, Vol. iv, p. 384—387.

† Vol. iv, p. 384; Vol. vi, p. 49.

stone leaning in a concave position towards the north*, on the transition slates of Malpasso, and on the south, on the gneiss granite of Parime. As the gypsum often immediately covers the sandstone of Calabozo, which appeared to me on the spot, to be identical with our soil of red sandstone, I am uncertain of the age of its formation. The secondary rocks of the *Llanos* of Cumana, Barcelona, and Caraccas, occupy a space of more than 5000 square leagues. Their continuity is so much the more remarkable, as they appear to be wanting, at least on the east of the meridian of Porto Cabello ($70^{\circ} 37'$) in the whole basin of the Amazon, unless they are covered by granitic sands. The causes which have favoured the accumulation of calcareous matter in the eastern region of the chain of the shore in the *Llanos* of Venezuela (from $10\frac{1}{2}^{\circ}$ to 8° north), have not acted nearer the equator, in the groupe of the mountains of Parime, and in the plains of the Rio Negro and the Amazon (lat. 8° north, to 1° south). The latter plains however, furnish some shelves of fragmented rocks, on the south-west of San Fernando de Atabapo, as well as towards the south-east, in the lower course of the Rio Negro and the Rio Branco. I saw a sandstone in the plains of Jaen de Bracamoros which alternates at the same time with

* Muldenformige Lagerung.

banks of sand, and conglomerated *galits* of porphyry and lydian *. MM. de Spix and Martius† affirm that the banks of the Rio Negro, on the south of the equator, are composed of variegated sandstone; those of the Rio Branco, Jupura, and Apoporis, of quader sandstone; and those of the Amazon on several points, of ferruginous sandstone‡. It remains to examine if, as I am now inclined to think, the limestone and gypsum formations of the eastern part of the Cordillera of the shore of Venezuela, differ entirely from those of the *Llanos*, and to what soil belongs that rocky wall § which, by the name of *Galera*,

* Geogn. Essay, p. 231.

† Ueber die Physiognomie des Pflanzenreichs in Brasilien, p. 13, 14.

‡ Braunes eisenschussiges Sandstein-Conglomerat (Ironsand of the English geologists, between the jura-limestone and green sandstone.) MM. Spix and Martius found on rocks of quadersunstein, between the Apoporis and the Japura, the same sculpture which we have made known from the Essequibo to the plains of Cassiquiare, and which seems to prove the migrations of a people more advanced in civilization than the Indians who now inhabit those countries. (Vol. v, p. 600.)

§ Vol. iv, p. 279. Is this wall a succession of rocks of dolomie or a dyke of quadersandstone, like *mer du Diable*, (*Teufelsmauer*,) at the foot of Harz? Calcareous bands (coral banks) either bands of sandstone (effects of the revulsion of the waves) or volcanic eruptions, are commonly found on the borders of great plains, that is, on the shores of antient inland seas. The *Llanos* of Venezuela furnish examples of

bounds the steppes of Calabozo, towards the north? The basin of the steppes is the bottom of a sea destitute of islands; it is only on the south of the Apure, between that river and the Meta, near the western bank of the Sierra, that some hills appear, Monte Parure*, la Galera de Sinaruco, and the Cerritos of San Vicente. With the exception of the fragments of tertiary soil which we have indicated above, we remark, from the equator to the parallel of 10° north between the meridian of Sierra Nevada de Merida and the coast of Guyana), if not an absence, at least a scarcity of the petrifications which strikes the geognosts recently arrived from Europe.

The *maxima* of the height of the different formations diminish regularly in the country we describe, with their *relative age*. These maxima for *gneiss-granite* (Peak of Duida in the groupe of Parime, Silla de Caraccas, in the chain of the shore) are from 1300 to 1350 toises; for the limestone of Cumanacoa (summit or Cucurucho

those eruptions near Parapara, like the Harudje (*Mons ater Plin.*) in the northern boundary of the African desert (the Sahara). Hills of sandstone rising like towers, walls, and strong castles, and offering a great analogy with the quadersandstone, bound the American desert towards the west, on the south of Arkansas. (Long. Vol. ii, p. 293, 389.)

* Near the Alto de Macachaba (manuscript of the Canon Madariaga).

of Turimiquiri), 1050 toises; for the limestone of Caripe (mountains that surround the table-land of the Guarda of San Agustin), 750 t.; for the sandstone alternating with the limestone of Cumanacoa (Cuchilla de Guanaguana), 550 t.; for the tertiary soil (Punta Araya) 200 t. It appears to me superfluous to remark, that the relations between the age of the formations, and the height they attain, vary definitely in other regions of the globe, where the secondary rocks often rise above the primitive. The study of the absolute height of rocks presents less interest since the geologists for the most part have abandoned the Wernerian hypothesis, of a fluid of which the level has progressively lowered in proportion as the different soils have been precipitated. In the hypothesis which attributes the inequalities of surface to heavings-up, recourse is had to the *waters of granite, gneiss, or mica-slate*, which have risen to different heights. The *maxima* of height give only the measure of the force which has acted against the oxidated crust of our planet. According to these views, therefore, the petrifications of pelagic shells which Mr. Bonpland and myself discovered on the ridge of the Peruvian Alps between Montan and Micuipampa, at the height of 2000 toises, in beds strongly inclined, are no proof that the antient level of the ocean had attained that limit.

The extent of country of which I state the geological constitution, is distinguished by the prodigious regularity observed in the *direction of the strata* of which the rocks of different ages are composed. In my personal narrative, and my *Essay on the position of soils*, I have already often fixed the attention of my readers on a geognostic law, which is one of the small number that can be verified by precise admeasurements. Occupied, since the year 1792, by the parallelism or rather the *loxodromism* of the strata, examining the direction and inclination of the primitive and transition-beds, from the coast of Genoa across the chain of the Bochetta, the plains of Lombardy, the Alps of Saint Gothard, the table-land of Swabia, the mountains of Bareuth, and the plains of northern Germany, I was struck with the extreme frequency, if not the constancy of the *hor.* directions 3 and 4 of the compass of Freiberg (direction from south-west to north-east). This research, which I thought might lead to important discoveries on the structure of the globe, had then such an attraction for me that it was one of the most powerful motives of my voyage to the equator. In joining my own observations with those of a great number of able geognosts, we perceive that there *exists in no hemisphere a general and absolute uniformity of direction, but that in regions of very considerable*

extent, sometimes on several thousand square leagues, we observe that the direction, and still more rarely the inclination, has been determined by a system of particular forces. We discover at great distances, a parallelism (loxodromism), a direction, of which the type is manifest amidst partial perturbations, and which often remains the same in primitive and transition soils. The direction of the strata pretty generally, and this fact must have struck Palasson and Saussure, even that of the waters which are far distant from the principal ridges, is identic with the direction of the chains of mountains, that is with their longitudinal axis.

In studying in a given system of rocks the relations which the direction of the strata present, either with the meridians or the horizon of the spot, I proposed to myself for every country, the following questions: Can we recognize a conformity of direction, a loxodromism of the strata, comprehended in a great extent, where are the perturbations so frequent that no law manifests itself? Is there a simultaneous constancy in the direction and the inclination, or are the strata running N. E.—S. W. sometimes inclined to the N. W., sometimes to the S. E.? Do the laws comprehend the formations of different ages, or may other relations of direction and inclination be observed in the primitive and secondary rocks? Are not the disturbances

themselves subject to certain rules, so that the partial changes of direction are most frequently 90° , and lead to a total change of * inclination? Is there a parallelism between the direction of the strata and that of the nearest chain of mountains, or has that direction of strata a relation with the principal chain, or a very distant oceanic coast? When we call the assemblage of rocks of which the strata have the same direction, a *loxodromic system of rocks*, and when, in a vast country, several of those *loxodromic systems* touch each other, are the changes of direction always sudden, or are there progressive passages on the limit of contiguous systems? The same soil does not furnish the traveller with the means of answering so great a number of important questions; but the progress of positive geognosy can only be ad-

* I allude to the case where, in a chain of mountains of mica-slate-gneiss, the general direction of the strata is *hor.* 4 (from S. W. to N. E.) with the inclination to the N. W., and where the deviations are generally *hor.* 8 (from S. E. to N. W.) The inclination observed in that *inverse direction* will not be as it would be towards the N. E., but towards the S. W. There is therefore a *total change* of inclination from north to south, or rather from N. W. to S. W. This regularity in the mode of deviation, which often occupied my attention in passing over the Andes, has lately engaged the attention of M. Steininger (*Erloschene Vulkane*, p. 3). and of M. Reboul, (*Journ. de Physique*, 1822, December, p. 425), on the banks of the Rhine, and in the Pyrenees.

vanced by never losing sight of the totality of the elements on which the knowledge of the general structure of the globe depends.

Venezuela is one of the countries in which the parallelism of the strata of gneis-granite, mica-slate, and clay-slate is most strongly marked. The general direction of these strata is N. 50° E., and the general inclination from 60° to 70° north-west. Thus I recognized them on a length of more than an hundred leagues, in the chain of the shore of Venezuela; in the stratified granite of las Trincheras near Porto-Cabello (Vol. iv, p. 197); in the gneiss of the isles of the lake of Valencia (Vol. iv, p. 122); and in the vicinity of the Villa de Cura; in the transition slate and greenstone on the north of Parapara (Vol. iv, p. 280); in the way from la Guayra to the town of Caraccas, and in all the Sierra de Avila (Vol. iii, p. 412, &c. and 488); in Cape Codera (Vol. iii, p. 375); and in the mica-slate and clayslate of the peninsula of Araya (Vol. ii, p. 285; Vol. vi, p. 99). The same direction from N. E. to S. W. and this inclination to the N. W., are again observed, although less decidedly, in the limestones of Cumanacoa (Vol. iii, p. 80) at Cuchivano; and between Guanaguana and Caripe. The exceptions* to this general law are extremely rare

* Vol. ii, p. 285; Vol. iii, p. 417—419; Vol. iv, 59, 74—77.

in the gneiss-granite of the Cordillera of the shore ; it may even be affirmed, that the *inverse direction* (from S. E. to N. W.) often bears with it the inclination towards the S. W.

As that part of the groupe of the Sierra Parime which I passed over, contains much more granite* than gneiss, and other rocks distinctly stratified, the direction of the layers could be observed in this groupe only on a small number of points ; but I was often struck in this region with the constancy of the phenomenon of *loxodromism*. The amphibolic slates of Angostura run N. 45° E. like the gneiss of Guapasoso (Vol. v, p. 224), which form the bed of the Atabapo, and like the micaslate of the peninsula of Araya, although there is a distance of 160 leagues between the limits of those rocks.

The direction of the strata, of which we have just related the prodigious uniformity, is not entirely parallel with the longitudinal axes of the two chains of the shore, and of Parime†. The strata generally cut the former of those chains under an angle of 35°, and their inclina-

* The granite of Baraguan only, is at the same time stratified, and crossed by veins of granite ; the direction of the beds is N. 20° W. (Vol. iv, p. 504.)

† Vol. iii, p. 448.

tion towards the north-west, becomes one of the most powerful causes of the dryness which prevails on the southern declivity* of the mountains of the coast. Can it be admitted that the direction of the eastern Cordillera of New Grenada, which is nearly N. 45° E., from Santa Fe de Bogota, to beyond the Sierra Nevada de Merida, and of which the chain of the shore is but a continuation, has had an influence on the direction (*hor.* 3-4) of the strata in Venezuela? That region presents a very remarkable *loxodromism* with the strata of mica-slate, grauwacke, and the orthoceratite limestone of the Alleghanies, and that immense extent of country (lat. 56° - 68°) lately visited by Captain Franklin†. The direction N. E.—S. W. prevails in every part of North America, as in Europe in the Fichtelgebirge of Franconia, in Taunus, Westerwald, and Eifel, in the Ardennes, in the Vosges, Cotentin, in Scotland, and in the Tarentaise, at the south-west extremity of the Alps‡. If the strata of rocks in Venezuela do not exactly follow the direction of the nearest Cordillera, that of the shore, the parallelism between the axis of one chain, and the

* Vol. iv, p. 62, &c., 249. This southern declivity is however less rapid than the northern.

† *Journey to the Polar Sea*, 1824, p. 529, 534.

‡ See my *Geognostic Essay*, p. 58.

strata of the formations that compose it, are so much the more manifest* in the groupe of Brazil.

SECTION III.

Nature of the Rocks.—Relative Age and Superposition of the Formations.—Primitive, transition, secondary, tertiary, and volcanic Soils.

The preceding section has developed the geographical limits of the formations, the extent of the direction of the zones of gneiss-granite, micaslate-gneiss, clayslate, sandstone, and intermediary limestone, which come successively to light. It remains to indicate succinctly the nature and relative age of these formations. In order not to confound *facts* with geognostic *opinions*, I shall describe these formations without dividing them, according to the method generally followed, into five groupes of primitive, transition, secondary, tertiary, and volcanic rocks. I was fortunate enough to discover the types of each groupe, in a region where, before my voyage, no rock had

* According to the manuscript notes of M. d'Eschwege, and his *Geogn. Gemälde von Brasilien*, p. 6. The strata of the primitive and intermediary rocks of Brazil run very regularly, like the Cordillera of Villarica (Serra do Espinhaço) *hor.* 1·4 or *hor.* 2 of the compass of Freiberg. (N. 28° E.) The inclination of the strata is generally towards the E.S.E.

been named. The great inconvenience of the antient classifications is that of obliging the geologist to establish fixed demarkations, while he remains in doubt, if not respecting the spot or the immediate superposition, at least on the number of the formations which are not developed. How can we pronounce in many circumstances, on the analogy which a limestone with but few petrifications may present with intermediary limestone, and zechstein, or a sandstone superposed on a primitive rock, with variegated sandstone and quadersandstone, or finally, muriatiferous clay, with the red marl of England, and the gem-salt of the tertiary soils of Italy? When we reflect on the immense progress made within twenty-five years, in the knowledge of the superposition of rocks, it will not appear surprizing that my present opinion on the *relative age* of the formations of Equinoxical America, is not identically the same with what I advanced in 1800. To boast of a stability of opinion in geognosy is to boast of an extreme indolence of mind; it is to remain stationary amidst those who go forward. What we observe in any one part of the earth on the composition of rocks, the subordinate beds they contain, and the order of their position, are facts immutably true, and independent of the progress of positive geognosy in other countries, while the systematic names imposed

on any particular formation of America, are founded only on the supposed analogies between the formations of America and those of Europe. Now, those names cannot remain the same, if, after further examination, the objects of comparison have not retained the same place in the geognostic series ; if the most able geologists now take for transition limestone, and green sandstone, what they took formerly for zechstein, and variegated sandstone. I believe the surest means by which geognostic descriptions may be made to survive the change which the science undergoes in proportion to its progress, will be to substitute provisionally, in the description of formations, for the systematic names of red sandstone, variegated sandstone, zechstein, and jura-limestone, names drawn from American localities (sandstone of Llanos, limestone of Cumanacoa and Caripe), and to separate the enumeration of facts which are relative to the superposition of soils, from the discussion on the analogy of those soils * with those of the antient continent.

* The whole of positive geography being nothing but a problem of the *series* or succession (either simple or periodical) of certain terms which represent the formations, it will be necessary, in order to understand the discussions contained in the third section of this memoir, to recapitulate succinctly the *table of formations* considered in the most general point of view. This sketch will rectify what was pub-

I. CO-ORDINATE FORMATIONS OF GRANITE, GNEISS, AND MICASLATE.

There are countries (in France, the vicinity of Lyons ; in Germany. Freiberg, Naundorf)

lished nine years ago, Vol. iii, p. 108. 1. *Soil, vulgarly called primitive* ; granite, gneiss, and micasl te (or oscillating gneiss, between granite and micasl te) ; very little primitive clay-slate ; weisstein with serpentine ; granite with disseminated amphibol ; amphibolic slate ; veins and short layers of greenstone. 2. *Transition soil*, composed of fragmentary rocks, (grauwacke,) calcariferous slate and greenstone (first traces of organization : bambousacees, madrepores, productus, trilobites, orthoceratites, evamphalites). Complex and parallel formations. a) alternate beds of grey and stratitous limestone, anthracitous micasl te, anhydre gypsum, and grauwacke ; b) clayslate, black-limestone, grauwacke with greenstone, syenites, transition-granite, and porphyries with a base of compact feldspar ; c) euphotides, sometimes pure and covered with jasper, sometimes mixed with amphibole, hyperstein, and grey limestone ; d) pyroenic porphyries with amygdaloides and zirconien syenites. 3. *Secondary soil*, beginning by a great destruction of monocotyledon plants. a) co-ordinate and almost contemporary formations with red sandstone (*rothes totes tiegende*), quarzier porphyry, and fern-coal. These beds are less connected by alternance than by opposition. The porphyries issue (like the trachytes of the Andes), in domes from the bosom of intermediary rocks. Porphyritic breccias, which envelope the quarzifere porphyries. b) Zechstein or Alpine limestone, with marno-bituminous slate, fetid limestone, and variegated gypsum ; Productus aculeatus. c) variegated sandstone (*bunte sandstein*) with frequent beds of limestone ; false oolithes ;

where the formations of granite and gneiss, are extremely distinct; there are others, on the contrary, where the geognostic limits between those formations are little marked, and where granite, gneiss, and mica-slate appear to alter-

the upper beds are of variegated marl, often muriatiferous (*red marl, salzthon*), with hydrated gypsum and fetid limestone. The gemsalt oscillates from zechstein to muschelkalk. d) limestone of Gottingen or muschelkalk, alternating towards the top with white sandstone or quadersandstein; (*Ammonites nodosus*, encrines, *Mytilus socialis*): clayey marl is found at the two extremities of muschelkalk. e.) while sandstone, quadersandstein, alternative with lias, or limestone a gryphees; a quantity of dicotyledons mixed with monocotyledon plants, f.) jura limestone, complex formation; a quantity of arenacious intercalated marl. We most frequently observe from below to above; lias (marlous limestone with gryphites), oolithes, limestone with polypiers, slaty limestone with fish, and crustaceans, and hydrated globular iron. *Amonites planulatus*, *Ghryphæa arcuata*. g.) secondary sandstone with lignites, iron sand; weald clay; green sand, or green sandstone h.) chlorite, tufted, and white chalk; (*planerkalk*, limestone of Verona). IV. *Tertiary soil*, beginning by a great destruction of decotyledon plants. a.) clay and tertiary sandstone with lignites; plastic clay; mollass, and nagelfluhe, sometimes alternating, where chalk is wanting, with the last beds of Jura limestone; succin. b.) limestone of Paris or coarse limestone, limestone with circles, limestone of Bolca, limestone of London, arenacious limestone of Bognor; lignites. c.) silicious limestone, and gypsum with bones alternating with marl. d.) sandstone of Fontainebleau. e.) lacustre soil with porous meulieres. e.) alluvial deposits.

nate by layers, or pass often from one to the other*. These alternations, and these passages, appeared to me less common in the Cordillera of the shore of Venezuela than in the Sierra Parime. We recognise successively, in the former of these two systems of mountains, above all, in the chain nearest the coast, as predominating rocks from west to east, granite (long. 70° — 71°) gneiss, (long. $68\frac{1}{2}^{\circ}$ — 70°), and mica-slate (long. $65\frac{3}{4}^{\circ}$ — $66\frac{1}{2}^{\circ}$); but considering in mass the geognostic constitution of the shore, and the Sierra Parime, we prefer to treat of granite, gneiss, and mica-slate, if not as one formation, at least, as three co-ordinate formations strictly linked together†. The clayey primitive slate (*urthonchiefer*), is subordinate to mica-slate, of which it is only a modification. It no more forms an *independant soil* in the New Continent, than in the Pyrenees and the Alps.

α. GRANITE which does not pass to gneiss is the most common in the western part of the chain of the shore, between Turmero, Valencia, and Porto Cabello, as well as in the circle of the Sierra Parime, near the Encaramada, and at the Peak of Duida. At Rincon del Diablo (Vol. iv. p. 167) between Mariara and Hacienda

* See my *Essay on the position of rocks in the two hemispheres*, p. 67, 69, 71, 74, 76.

† See above, Vol. iv, p. 277; Vol. v, p. 857, 858.

de Cura, and at Chuao (Vol. iv. p. 116, 167), it has large grains, containing fine crystals of feldspar, $1\frac{1}{2}$ inches long. It is divided in prisms by perpendicular vents, or stratified regularly, like secondary limestone, at las Trincheras (Vol. iv, p. 198); the strait of Baraguan in the valley of the Oroonoko, (Vol. iv, p. 502), and near Guapasoso, on the banks of the Atabapo (Vol. v, p. 224). The stratified granite of the Trincheras, giving birth to very hot springs (from $90\cdot3^{\circ}$ cent.), appears from the inclination of its layers, superposed upon gneiss, which is seen further southward in the islands of the lakes of Valencia; but conjectures of superposition founded only on the hypothesis of an indefinite prolongation of the strata, are little certain; and perhaps the granite masses which form a small particular zone in the northern range of the Cordillera of the shore, between $70^{\circ} 3'$, and $70^{\circ} 50'$ of longitude * were heaved-up in piercing the gneiss. The latter rock is prevalent, both in descending from the Rincon del Diablo towards the south, to the hot-springs of Mariara, and towards the banks of the lake of Valencia, and in advancing on the east towards the groupe of Buenavista, and the Silla of Caraccas, and Cape Codera. In the region of

* In supposing Nueva Valencia long. $70^{\circ} 34'$, and Villa de Curalong, $70^{\circ} 5'$.

the chain of the shore of Venezuela, where granite seems to constitute an independent formation from 15 to 16 leagues in length, I saw no *foreign or subordinate layers* of gneiss, mica-slate, or primitive limestone *.

The Sierra Parime is one of the most extensive granitic soils existing on the globe †; but the granite which is seen alike bare on the flank of the mountains, and in the plains by which they are joined, often passes to gneiss. (Vol. iv, p. 552.) Granite is most commonly found in its granular composition, and independent formation, near the Encaramada (Vol. iv, p. 462), at the strait of Baraguan, (Vol. iv, p. 502), and in the vicinity of the mission of the Esmeralda. It often contains, like the granites of the Rocky Mountains (lat. 38°—40°), the Pyrenees, and Southern Tyrol, amphibol crystals ‡, disseminated in the mass,

* Primitive limestone, every where so common in mica-slate and gneiss, is found in the granite of the Pyrenees, at port d'Oô, and in the mountains of Labourd (*Charpentier, sur la const. geogn. des Pyrenees*, p. 144, 146.

† See above, Vol. vi, p. 501, 520. To prove the extent of the continuity of this granitic soil, it will suffice to observe that M. Lechenault de la Tour, collected in the bars of the river Mana, in French Guyana, the same gneiss granites (with a little amphibol) which I observed three hundred leagues more to the west, near the confluence of the Oroonoko and the Guaviare.

‡ I did not observe this mixture of amphibol in the gra-

but without passing to syenite (Vol. v, p. 18, 435). Those modifications are observed on the banks of the Oroonoko, the Cassiquiare, the Atabapo, and the Tuamini. The blocks heaped together which are found in Europe on the ridge of granitic mountains (Riesengebirge in Silesia, Ochsenkopf in Franconia), are above all remarkable in the north-west part of the Sierra Parime, between Caycara, the Encaramada, and Uruana, in the cataracts of the Maypures and at the mouth of the Rio Vichada (Vol. v, p. 177). It remains doubtful if these heaved-up masses, of cylindric form (Vol. iv, p. 540), parallelipedes rounded on the edge, or balls of 40 to 50 feet in diameter (Vol. v, p. 616, &c.), are the effect of a slow decomposition, or of a violent and instantaneous heaving-up. The granite of the south-east part of Sierra Parime sometimes passes to *pegmatite* *, composed of laminary feldspar, enclosed in curved masses of crystalline quartz. I saw gneiss only in *subordinate layers* †; but, between Javita, San Car-

nite of the chain of the coast of Venezuela, unless at the summit of the Silla de Caraccas (Vol. iii, p. 505).

* *Schrift-granit*. It is a simple modification of the composition and texture of granite, not even a subordinate layer. It must not be confounded with the real pegmatite, generally destitute of mica, or with the *geographic stones* (*pedras mapajas*) of the Oroonoko (Vol. v, p. 559), which contain streaks of dark green mica variously turned.

† The magnetic sands of the rivers that furrow the gra-

los del Rio Negro, and the Peak of Duida, the granite is traversed by numerous veins of different ages (Vol. v, p. 401), spread over with rock-crystal, black tourmaline, and pyrites (Vol. v, p. 229, 506). It appears that these open veins become more common on the east of the Peak of Duida, in the Sierra Pacaraina, above all between Xurumu, and Rupunuri (tributary streams of the Rio Branco, and the Essequibo), where Hortsman the traveller, discovered instead of diamonds * and emeralds, a mine, or oven of rock-crystal (Vol. v, p. 792; Vol. vi, p. 518).

β. GNEISS predominates along the Cordillera of the shore of Venezuela with the appearances of an independant formation in the northern

nitic chain of the Encaramada (Vol. vi, p. 502), seem to denote the proximity of amphibolic or chloritic slate (*hornblend* or *chlorit schiefer*), either in layers in the granite, or superposed on that rock (Vol. v, p. 678).

* These fables of *diamonds* are very ancient on the coast of Paria. Petrus Martyr relates, that at the beginning of the sixteenth century, a Spaniard, Andrès Morales, bought of a young Indian of the coast of Paria “*adamantem mire pretiosum, duos infantis digiti articulos longum, magni autem pollicis articulum æquantem crassitudine, acutum utrobique et costis 8 pulchre formatis constantem.*” This pretended *adamus juvenis pariensis* resisted the lime. Petrus Martyr distinguishes it from topazes by adding, “*offenderunt et topazios in littore,*” that is, on the coast of Paria, Saint Martha, and Veragua. See *Oceanica*, Dec. iii, lib. iv, p. 53.

chain, from Cerro del Chuão, and the meridian of Choroni, as far as Cape Codera; and in the southern chain, from the meridian of Guigue, to the mouth of the Rio Tuy. Cape Codera, (Vol. iii, p. 375), the great mass of the Silla, of Galipano, and the land between Guayra and Caraccas (Vol. iii, p. 417, 520, 527, 528, 532), the table-land of Buenavista (Vol. iv, p. 74), the islands of the lake of Valencia (Vol. iv, p. 161, 168, 177), the mountains between Guigue, Maria Magdalena, and the Cerro de Chacao (Vol. ii, p. 273, 277), are composed of gneiss*; yet amidst this soil of gneiss, inclosed micaslate reappears, often talquous in the Valle de Caurimare, and in the ancient Provincia of los Mariches (Vol. iii, p. 531); at Cabo Blanco, west of la Guayra (Vol. iii, p. 402); near Caraccas and Antimano (Vol. iv, p. 59, 60), and above all, between the table-land of Buenavista, and the vallies of Aragua, in the mountain of the Cocuyzas and at Hacienda del Tuy (Vol. iv, p. 78, 91). Between the limits which we have here assigned to gneiss, as a predominant rock (long. $68\frac{1}{2}^{\circ}$ — $70\frac{1}{2}^{\circ}$), gneiss passes sometimes to mica-

* I have been assured that the islets Orchila and Los Frailes are also composed of gneiss. Curaçao and Bonaire are calcareous. Is the island of Oruba, in which *pepites* of native gold of a considerable size have lately been found, primitive?

slate, while the appearance of a passage to granite is only found on the summit of the Silla de Caraccas* (Vol. iii, p. 508); it would still require to be examined with more care than I was able to do, whether the granite of the top of Saint Gothard, and of the Silla of Caraccas, reposes effectively on micaslate and gneiss, or if it has merely *pierced* those rocks rising in the form of needles, or domes. The gneiss of the Cordillera of the shore, in the province of Caraccas, contains almost exclusively garnets, rutile, titanite and graphite, disseminated in the whole mass of the rock (Vol. iii, p. 417, 418); shelves of granular limestone (*ib.*) and some metalliferous veins (Vol. iii, p. 525, 532; Vol. iv, p. 269). I shall not decide whether the grenatiferous *serpentine* of the table-land of Buenavista be inclosed in gneiss, or whether, superposed upon that rock, it do not rather belong to a formation of *weisstein* (heptinite) similar to that of Penig and Mittweyde in Saxony (Vol. iv, p. 79, 92).

In that part of the Sierra Parime which M. Bonpland and myself visited, gneiss forms a less marked zone, and *oscillates* more frequently towards granite than micaslate. I found no garnets in the gneiss of Parime. There is no

* The Silla is a mountain of gneiss like Adam's Peak (in the island of Ceylon), and of nearly the same height.

doubt that the gneiss-granite of the Oroonoko is a little auriferous on some points (Vol. iv, p. 471 ; Vol. v, p. 678, 857 ; Vol. vi, p. 215).

γ. *Micaslate* forms with clayslate (*thon-schiefer*), a continued soil in the northern chain of the Cordillera of the shore, from the point of Araya, beyond the meridian of Cariaco, as well as in the island of Marguerita. It contains, in the peninsula of Araya, garnets disseminated in the mass, cyanite (Vol. ii, p. 285), and when it passes to clayey-slate, small layers of native alum (Vol. vi, p. 93, 99, 102). Micaslate constituting an independant formation, must be distinguished from micaslate subordinate to a soil of gneiss, on the east of Cape Codera. The micaslate subordinate to gneiss, displays in the valley of Tuy, shelves of primitive limestone (Vol. iii, p. 92), and small layers of graphic ampelite (*zeicheschiefer*); between Cape Blanc and Catia, layers of chloritic, granatiferous slate, and slaty amphibol (Vol. iii, p. 404); and between Caraccas and Antimano, the more remarkable phenomenon of veins of gneiss inclosing balls of granatiferous diorite* (*grunstein*) (Vol. iv, p. 59, 60).

In the Sierra Parime, micaslate predominates only in the most eastern part, where its lustre has given rise to strange errors (Vol. v, p. 838,

* See my geognostic Essay, p. 337.

857). The *amphibolic slate* of Angostura (Vol. v, p. 699), and masses of *diorite* in balls, with concentric layers, near Maitaco (Vol. v, p. 691), appear to be superposed, not on micaslate, but immediately on gneiss-granite. I could not, however, distinctly ascertain whether a part of this pyritous diorite was not inclosed on the banks of the Oroonoko, as it is at the bottom of the sea near Cabo Blanco (Vol. iii, p. 405), and at the Montaña de Avila, in the rock that it covers. Very large veins, with an irregular direction, often assume the aspect of *short layers*; and the balls of *diorite* heaped together in hills, may well, according to the analogy of so many cones of basalt, have issued from the crevices.

Micaslate, chloritic slate, and the rocks of slaty amphibol, contain magnetic sand in the tropical regions of Venezuela, as in the most northern regions of Europe. The garnets are there almost equally disseminated in the gneiss (Caraccas), the micaslate (peninsula of Araya), the serpentine (Buenavista), the chloritic slate (Cabo Blanco), and the diorite or greenstone (Antimano): we shall see further on, that these garnets re-appear in the trachytic porphyries that crown the celebrated metalliferous mountain of Potosi, and in the black and pyroxenic masses of the small volcano of Yana-Urcu, at the back of Chimborazo.

The petroleum, and this phenomenon is well worthy of attention, issues from a soil of mica-slate in the gulph of Cariaco (Vol. ii, p. 290). If, further east, on the banks of the Arco (Vol. iii, p. 97; Vol. iv, p. 51), and near Cariaco (Vol. ii, p. 216, 290), it seems to gush from secondary limestone formations, it is probably only because those formations repose on mica-slate (Vol. vi, p. 97). The hot springs of Venezuela have also their origin in, or rather below, the primitive rocks. They issue from granite (Las Trincheras), gneiss (Mariara and Onoto), and the calcareous and arenacious rocks that cover the primitive rocks (Morros de S. Juan, Bergantin, Cariaco). The earthquakes and subterraneous detonations, of which the seat has been erroneously sought in the calcareous mountains of Cumana, have been felt with most violence in the granitic soils of Caraccas, and the Oroonoko (Vol. iv, p. 24, 45). Igneous phenomena (if their existence be really well certified), are attributed by the people to the granitic peaks of Duida and Guaraco, and also to the calcareous mountain of Cuchivano (Vol. iii, p. 83; Vol. v, p. 550, 551).

From the whole of these observations, it results, that gneiss-granite predominates in the immense groupe of the mountains of Parime, as mica-slate-gneiss does in the Cordillera of the shore; that in the two systems, the granitic

soil, unmixed with gneiss and micaslate, occupies but a very small extent of country; and that in the chain of the shore, the formations of clayey slate (*thonschiefer*), micaslate, gneiss, and granite, succeed each other in such a manner on the same band from east to west (presenting a very uniform and regular inclination of their strata towards the north-west), that according to the hypothesis of a subterraneous prolongation of the strata, the granite of las Trincheras and the Rincon del Diablo, may be superposed on the gneiss of the Villa de Cura, of Buenavista, and Caraccas; and the gneiss superposed in its turn, on the micaslate and clayslate of Maniquarez and Chuparuparu in the peninsula of Araya. I have already observed in another place, that this hypothesis of a prolongation of every rock, in some sort indefinite, founded on the angle of inclination which the strata present on the surface of the soil, is not admissible, and that according to similar and equally vague reasoning, we should be forced to consider the primitive rocks of the Alps of Switzerland as superposed on the formation of the compact limestone of Achsenberg, and that limestone (of transition, or identical with zechstein?) as being superposed on the mollassus of tertiary soil.

II. FORMATION OF CLAYEY-SLATE (THONSCHIEFER) OF MALPASSO.

If, in the sketch of the formations of Venezuela, I had followed the received division into primitive, intermediary, secondary, and tertiary soils, I might be doubtful what place the last layer of micaslate should occupy in the peninsula of Araya. This layer, in the ravine (Aroyo) of Robalo, passes insensibly in a carburated and shining slate, into a real ampelite. The direction and inclination of the strata remain the same, and the *thonschiefer*, which takes the aspect of a *transition-rock*, is but a modification of the primitive micaslate of Maniquarez, containing garnets, cyanite, and rutile titanite (Vol. vi, p. 101, 102). These insensible passages from primitive, to transition soil, by clayey slate that becomes carburated, at the same time that it presents a *concordant position* with micaslate and gneiss, have also been observed several times in Europe * by celebrated geognosts. The existence of an independent formation of *primitive slate* (*urthonschiefer*), may even be doubted, that is, of a formation which

* See the excellent work of M. de Oeynhausien, *Versuch einer géogn. Beschreib. von Oberschlesien*, 1822, p. 57, 62, 415.

is not linked below by layers containing some vestiges of monocotyledon plants.

The small *thonschiefer* bed of Malpasso (in the southern chain of the Cordillera of the shore), is separated from micaslate-gneiss by a co-ordinate formation of serpentine and diorite. It is divided into two shelves, of which the upper presents green steatitous slate, mixed with amphibol; and the lower, dark-blue slate, extremely fissile, and traversed by numerous veins of quartz (Vol. iv, p. 281). I could discover no fragmentary layer (*grauwacke*), nor *kieselschiefer*, nor chiasiolithe. The *kieselschiefer* belongs in those countries to a limestone formation, which we shall soon describe; I have seen fine specimens of the chiasiolithe (macle) which the Indians wore as amulets, and which came from the Sierra Nevada de Merida. This substance is probably found in transition-slate, for MM. Rivero and Boussingault observed rocks of clay-slate at the height of 2120 toises, in the Paramo of Mucuchies, in going from Truxillo to Merida*.

* In Galicia, in Spain, I saw the *thonschiefer* alternate, which contains chiasiolithe with *grauwacke*; but the chiasiolithe belongs indubitably also to rocks which all geognosts have hitherto named primitive rocks, to mica-schistes intercalated like layers in the granite, and to a soil of independent micaslate (*Charpentier*, p. 143, 193).

III. FORMATION OF SERPENTINE AND DIORITE (GREENSTONE OF JUNCALITO).

We have indicated above, a layer of granatiferous serpentine inclosed in the gneiss of Buenavista, or perhaps superposed on that rock ; we here find a real soil of serpentine, alternating with diorite, and extending from the ravine of Tucutunemo as far as Juncalito. The diorite forms the great mass of this soil ; it is of a dark-green colour, granular with small grains, and destitute of quartz ; its mass is formed of small crystals of feldspar, intermixed with crystals of amphibol. This rock of diorite is covered at its surface, by the effect of decomposition, with a yellowish crust like that of basalts, and dolerites. *Serpentine* of a dull olive-green, and smooth fracture, mixed with blueish steatite, and amphibol, presents, like almost all the *co-ordinate formations of diorite and serpentine* (in Silesia, at Fichtelgelirge, in the valley of Baignorrie, in the Pyrenees, in the isle of Cyprus, and in the copper mountains of circumpolar America) *, traces of copper (Vol. iv, p. 279). Where the diorite, partly globular, draws near the green slate of Malpasso, real beds of green slate are found inclosed in diorite.

* Franklin's Journal to the Polar Sea, p. 529.

The fine saussurite which we saw in the Upper Oroonoko in the hands of the Indians, seems to indicate the existence of a soil of euphotide, superposed on gneiss-granite, or the amphibolic slate of the eastern part of Sierra Parime. (Vol. v, p. 383, 384, 563, &c.)

IV. GRANULAR AND MICACEOUS LIMESTONE OF THE MORROS OF SAN JUAN.

The Morros of San Juan rise in a soil of diorite, like towers in ruin. They are formed of a cavernous greyish green limestone, of crystalline texture, mixed with some spangles of mica, and destitute of shells. We recognize in them masses of hardened clay, black, fissile, charged with iron, and covered with a crust, yellow from decomposition, like basalts and amphibolites. A compact limestone containing vestiges of shells, is joined to this granular limestone of the Morros of San Juan, which is hollow within (Vol. iv, p. 279 ; Vol. vi, p. 583). It is probable that in further examining the extraordinary soil, between Villa de Cura and Ordiz, in which I could only collect specimens of rock during one day, many phenomena may be discovered analogous to those which M. Leopold de Buch has lately described in South Tyrol *.

* *Tyroler Bothe vom 26 ten Julius, 1822 ; and Geognostic Letter of M. de Buch to M. de Humboldt, 1823, p. 13.*

M. Boussingault, in a very instructive memoir which he has recently addressed to me, calls the rock of the Morros a "problematic calciferous gneiss." This expression seems to prove that the plates of mica take in some parts an uniform direction, as in the greenish dolomie of Val Toccia.

V. FELSPATHIC SANDSTONE OF THE OROONOKO.

The soil of gneiss-granite of the Sierra Parime is covered by fragments, (between the Encaramada and the strait of Baraguan, and in the Island of Guachaco), in its western part, of an olive-brown sandstone, containing grains of quartz, and fragments of feldspar, joined by a clayey-cement, extremely compact. This cement, where it abounds, has a conchoid fracture, and passes to jasper. It is crossed by small veins of brown iron-ore, which separate into very thin plates, or blades. (Vol. iv, p. 573.) The presence of feldspar seems to indicate that this small formation of sandstone (the sole secondary formation hitherto known in the Sierra Parime), belongs to red-sandstone or coal *. I have hesitated to join it to the sand-

* Broken or intact crystals of feldspar are found in the *tote liegende*, or coal sandstone of Thuringia (*Freiesleben geogn. Arbeiten*, Vol. iv, p. 82, 85, 96, 194). I observed in

stone of the Llanos, of which the relative antiquity has appeared to me to be less verified.

VI. FORMATION OF THE SANDSTONE OF THE LLANOS OF CALABOZO.

I place the formations in the successive order which I thought I perceived from my first impressions on the spot. The carburated slate or thonschiefer of the peninsula of Araya connect the primitive rocks of gneiss-granite, and mica-slate gneiss, with the transition soil (blue and green slate, diorite, and serpentine mixed with amphibol, granular greenish-grey limestone) of Molpasso, Tucutunemo, and San Juan. Towards the south, the *sandstone of the Llanos* rests on this transition-soil; it is destitute of shells, and composed (sayannahs of Calabozo) of rounded fragments of quartz *, kieselschiefer and lydian,

Mexico a very singular agglomerated feldspathic formation, superposed upon, perhaps inclosed in, red sandstone, near Guanaxuato. See my *Political Essay*, Vol. ii, p. 179, 180; and my work on the *position of rocks*, p. 28.

* In Germany, sandstones which belong indubitably to red sandstone, contain also (near Weiderstadt, in Thuringia) galets, and rounded fragments (*Friesleben*, Vol. iv, p. 77). They have on that account been designated by the name of *nagelfluhe* (Meinicke, in the *Naturforscher*, St. 17, p. 48). I shall not cite the pudding-stones subordinate to the red sandstone of the Pyrenees, because the age of that sandstone, destitute of coal, may be contested (*Charpentier*, p.

cemented by a ferruginous, olive-brown clay. (Vol. iv, p. 384, 385.) We there find fragments of wood, in great part monocotyledon, and masses of brown iron. Some layers (Mesa de Paja) present grains of very fine quartz; I saw no fragments of porphyry, or limestone. Those immense beds of sandstone that cover the Llanos of the Lower Oroonoko and the Amazon, merit the greatest attention of travellers. By their aspect they draw near the nagelfluhes or pudding-stones of the molassus soil, in which calcareous vestiges are also often wanting, (Schottwyl and Diesbach, in Switzerland*); but they appeared to me by their position to have rather a relation to *red sandstone*. They can no where be confounded with the grau-wackes (fragmentary transition-rocks) which MM. Boussingault and Rivero † found along

427). Layers of very fine rounded gneiss of quartz are inclosed in the *tote liegende* of Thuringia, (*Freiesleben*, Vol. iv, p. 97) and in Upper Silesia (*Ocyhaussen, Besch. von Oberschlesien*, p. 119).

* *Meisner, Annalen der allgem. schweiz. Gesellschaft*, P. I. p. 49.

† Those travellers not only levelled their route by means of the barometer, but also determined the position of a great number of points by meridian observations of the Sun and Canopus, and by the use of a time-keeper. I shall here transcribe some latitudes that are very uncertain on our maps: Maracay, $10^{\circ} 15' 58''$; San Carlos, $9^{\circ} 40' 10''$; Barquisimeto, $9^{\circ} 54' 35''$; Tocuyo, $9^{\circ} 15' 51''$; Truxillo,

the Cordilleras of New Grenada, bordering the steppes on the west. Does the want of fragments of granite, gneiss, and porphyry, and the frequency of petrified wood *, sometimes dicotyledons, indicate that those sandstones belong to more recent formations, which fill the plains between the Cordilleras of Parime and the shore, as the molassus of Switzerland fills the space between the Jura and the Alps? I dis-

8° 59' 36''; Pamplona, 7° 17' 3''. The following are the names of the towns which MM. Boussingault, Rivero, and myself have observed at different epochas, but not always in the same settlements. The first latitude is that which I have published; the second, that of the two travellers I have just named; Caraccas, 10° 30' 50''; 10° 30' 58''; Valencia, 10° 9' 56''; 10° 10' 34''; Villa de Cura, 10° 2' 47''; 10° 3' 44''; S. Juan de los Morros, 9° 55' 0''; 9° 55' 50''; Honda, 5° 11' 45''; 5° 11' 20'': M. Boussingault estimates the latitude of Merida 8° 16' 0''.

* The people attribute those woods to *Bowdichia virgiloides* or Alcornoco, (See my *Nova Gen. and Spec.* Vol. iii, p. 377), and to Chapara Bovo (*Rhopala complicata*). It is believed in Venezuela, as in Egypt, that petrified wood is formed in our times. I shall here observe that I found this decotyledon petrified wood only at the surface of the soil, and not inclosed in the sandstone of the Llanos. M. Caillaud made the same observation in going to the Oasis of Siwa. The trunks of trees 90 feet long, inclosed in the red sandstone of Kifhauser (in Saxony), are, according to the recent researches of M. de Buch, divided into knots, and are certainly monocotyledons.

cussed this problem in another work * ; but the materials hitherto collected are too incomplete. It is not easy, when several formations are not yet developed, to pronounce on the age of arenacious rocks. Even in Germany, the classic soil of geognosy, the most able observers are not agreed on the sandstone of the Black Forest, and of the whole country south-west of Thuringer-Waldgebirge. M. Boussingault, who passed through a part of the steppes of Venezuela long after me, is of opinion that the *sandstone* of the *Llanos* of San Carlos, that of the valley of San Antonio of Cucuta, and the tablelands of Barquisimeto, Tocuyo, Merida, and Truxillo, belong to a formation of *antient red sandstone*, or coal. There is in fact real coal near Carache, south-west of Paramo de las Rosas.

Before a part of the immense plains of America was geognostically examined, it might have been supposed that their uniform and continued *horizontal*ity, was owing to alluvial soils, or at least to arenacious tertiary soils. The sands which in the *country of the Baltic*, and in all the north of Germany cover coarse limestone and chalk, seem to justify these systematic ideas, which have not failed to be ex-

* *Sur le gisement des roches dans les deux hémisphères*, p. 230.

tended to the Sahara, and the steppes of Asia. But the observations which we have been able to collect, suffice to prove that in both worlds, the plains, the steppes, and the deserts, contain a great number of formations of different ages, and that those formations often appear without being covered by alluvial deposits. The Jura-limestone, gem-salt, (plains of the Meta and Patagonia) and coal sandstone, are found in the Llanos of South America; the quadersandstone * (desart between the Arkansas, and the Canadian river; River Plata), a saliferous soil, beds of coal †, (declivity of the Alleghanies, banks of the Ohio), and limestone with ‡ trilo-

* Long. Expedition, Vol. ii, p. 293. The physiognomy of these rocks cut in walls and pyramids, or divided in *rhomboid* blocks, seems no doubt to characterize the quadersandstone; but the sandstone of the eastern declivity of the Rocky Mountains, in which the learned traveller Mr. James, found salt-springs (*licks*), layers of gypsum, and no coal, (*L. c.* Vol. ii, p. 397, 404,) appear rather to belong to variegated sandstone (*bunte sandstein*).

† *L. c.* Vol. i, p. 15. This coal immediately covers, as in Belgium, the grauwacke, or transition-sandstone.

‡ *L. c.*, Vol. i, p. 147. In the plains of the Upper Missouri the limestone is immediately covered by a secondary limestone with *turritulles*, believed to be jurassic, while a limestone with grypchees, rich in lead-ore, and which I should have believed to be still more antient than oolitic limestone and analogous to *lias*, is, according to Mr. James, (*L. c.*, Vol. ii, p. 412,) placed above the most recent formation of sandstone. Has this superposition been well ascertained?

bites (Missouri above Council Bluff), fill the vast plains of Louisiana and Canada. In examining the rocks which the indefatigable Caillaud has collected in the Lybian desert, and in the Oasis of Siwa, we recognize sandstone similar to that of Thebes; fragments of petrified dicotyledon wood (from 30 to 40 feet long), with rudiments of branches and medullary concentric layers, coming perhaps from tertiary sandstone with lignites*; chalk, with *spatanges* and anachytes, limestone (jurassic) with nummulites partly agatized; another limestone with small grains† employed in the construction of the temple of Jupiter Ammon (Omm-Beydah); and gemsalt with sulphur and bitumen‡. These examples sufficiently prove that the plains, (*Llanos*,) steppes, and deserts, have not that uniformity of tertiary rocks which has been too generally supposed. Do the fine pieces of ribboned-jasper, or *pebbles* of Egypt, which M. Bonpland picked up in the

* Formation of molassus.

† M. de Buch justly enquires if this statuary limestone, which resembles the marble of Paros, and limestone become granular by its contact with the systematic granite of Predazzo, is a modification of the limestone with nummulites of Siwa? The primitive mountains from which the marble with small grains was believed to be extracted, if there is no deception in its granular appearance, are far distant from the Oasis of Siwa.

‡ Caillaud et Drovetti, *Voyage à Syouah*, p. 8, 9, 16.

savannahs of Barcelona (near Curataquiche), belong to the sandstone of the Llanos of Calabozo, or to a soil superposed on that sandstone? The former of these suppositions would approach, according to the analogy of the observations made by M. Roziere in Egypt, the sandstone of Calabozo of tertiary *nagelfluhe*. (Vol. vi, p. 49).

VII. FORMATION OF COMPACT LIMESTONE OF CUMANACOA.

A blueish-grey compact limestone, almost destitute of petrifications, often crossed by small veins of carburated lime, forms mountains with very abrupt ridges. These layers have the same direction and the same inclination (Punta Delgada, on the east of Cumana) as the mica-slate of Araya. Where the flank of the limestone mountains of New Andalusia is very steep, we observe, as at Achsenberg, near Altorf, in Switzerland, layers that are singularly arched or turned. The tints of the limestone of Cumanacoa vary from darkish-grey to bluish-white (Bordones; centre of Cerro del Impossible; Cocollar; Turimiquiri; Montaña de Santa-Maria), and sometimes pass from compact to granular. (Vol. ii, p. 263; iii, p. 11, 76, 80, 94, 175.) It contains, as *substances accidentally disseminated* in the mass, brown-

iron-ore, spathic iron, (Vol. iv, p. 384,) and even rock-crystal *; and as subordinate layers, 1st. numerous strata of carburated and slaty marl, with pyrites (Cerro del Cuchivano, near Cumanacoa); 2d. quartzous sandstone, alternating with very thin strata of clayey slate. (Quetepe, south of Cumana; Cerro del Imposible; table-land of Cocollar; Cerro de Saca Manteca, near Catuaro, probably also the basin of Guarda de San Agustin, and the Purgatorio). This sandstone contains springs. In general it only covers the limestone of Cumanacoa, but it appeared to me to be sometimes inclosed (Vol. iii, p. 11, 23, 94, 181); 3d. gypsum with sulphur, near Guire, in the Golfo Triste, on the coast of Paria (Vol. iv, p. 386). As I did not examine on the spot the position of this yellowish-white gypsum with small grains, I cannot pronounce with certainty on its *relative age*. The only petrifications of shells which I found in this limestone formation, are a heap of turbinites and trochites on the flank of Turimiquire, at more than 680 toises high, and an ammonite seven inches in diameter, in the *Montaña de Santa Maria*, north north-west of Caripe. I no where saw the *limestone of Cumanacoa*, of which I treat specially in this ar-

* The zechstein of Gross-Oenner in Thuringia, also incloses rock-crystal. *Freiesleben*, Vol. iii, p. 17.

ticle, repose on the *sandstone of the Llanos* ; if this superposition takes place, it must be found in descending the table-land of Cocollar towards the Mesa of Amana. On the southern coast of the gulph of Cariaco, the limestone-formation (Punta Delgada), probably covers, without the interposition of another rock, the micaslate that passes to carburated clayslate. In the northern part of the gulph I saw distinctly this clayey formation at the depth of two or three fathoms in the sea. The sub-marine hot-springs (Vol. iii, p. 199) appeared to me to gush from micaslate, like the petroleum of Maniquarez (Vol. ii, p. 290). If any doubts remain as to the rock on which the *limestone of Cumanacoa* is immediately superposed, there is none respecting the rocks which cover it, such as 1st. the tertiary limestone of Cumana, near Punta Delgada, and at Cerro de Meapire (Vol. iii, p. 181); 2d. the sandstone of Quetepe and Turimiquiri, which forming layers also in the limestone of Cumanacao, belongs properly to the latter soil; the limestone of Caripe, which we have often identified, in the course of this work, with jurassic limestone, and of which we shall speak in the following article.

VIII. FORMATION OF COMPACT LIMESTONE OF CARIBE.

In descending the Cuchilla of Guanaguana towards the convent of Caripe, we find another

more recent formation, white, with smooth fracture, or imperfectly conchoid, and divided in very thin layers, which (Vol. iii, p. 107,) succeeds to the *bluish-grey limestone formation of Cumanacoa*. I call this in the first instance the *limestone formation of Caripe*, on account of the cavern of that name which is inhabited by thousands of nocturnal birds. This limestone appeared to me identical, 1st. with the limestone of Morro de Barcelona, and the Chimanas Islands (Vol. iii, p. 365 ; Vol. vi, p. 80) which contains small layers of black *kieselschiefer*, (slaty jasper,) destitute of veins of quartz, and breaking into fragments of parallelopiped form ; 2d. with whitish-grey limestone, with smooth fracture of Tisnao, which seems to cover the sandstone of the Llanos (Vol. iv, p. 386). We find the *formation of Caripe* in the Island of Cuba (between the Havannah and Batabano, and between the port of Trinidad and Rio Guaurabo), as in the islets of the Caymans.

I have hitherto described the secondary limestone-formations of the chain of the shore, without giving them the *systematic names* which may connect them with the formations of Europe. During my stay in America, I took the *limestone of Cumanacoa* for *zechstein*, or *alpine limestone*, and that of *Caripe* for *jurassic limestone*. The carburated and slightly bituminous marl of Cumanacoa, analogous to the

layers of bituminous slate, which are very numerous * in the Alps of South Bavaria, appeared to me to characterize the former of these formations; while the dazzling whiteness of the cavernous soil of Caripe, and the form of those steps of rocks rising in walls and cornises, brought strongly to my mind the jurassic limestone of Streitberg, in Franconia, or of Oitzow, and Krzessowice, in Upper Silesia. There is a suppression in Venezuela of the different soils, which, in the antient continent, separate zechstein from jura-limestone. The sandstone of Cocollar, which sometimes covers the limestone of Cumanacoa, may be considered as *variegated sandstone*; but it is more probable that in alternating by layers with the limestone of Cumanacoa, it is sometimes repulsed to the upper limit of the formation to which it belongs. The zechstein of Europe also contains very quartzous sandstone †. The two limestone soils of Cumanaco and Caripe succeed each other immediately, like the alpine and jura limestone on the western declivity of the Mexican table-land, between Sopilote, Mescala, and Tehuilotepic. These formations perhaps pass from one to the other, so that the

* I found them also in the Peruvian Andes, near Montau, at 1600 toises high.

† See my *Geogn. Essay*, p. 257.

latter may be only an upper shelf of zechstein. This immediate covering *, this suppression of interposed soils, this simplicity of structure, and absence of oolitic layers, have been equally observed by able geognosts, in Upper Silesia and in the Pyrenees †. On the other hand, the immediate superposition of the limestone of Cumanacoa on mica-slate and transition clayslate, the rarity of the petrifications which have not yet been sufficiently examined, the layers of silex passing to lydian stone, may lead to the belief that the soils of Cumanacoa and Caripe are of a much more antient formation than the *secondary* rocks. We must not be surprised that the doubts of the geognost, when obliged to decide on the relative age of the *limestone of the high mountains* in the Pyrenees, the Appenines (south of the lake of Perugia,) and in the Swiss Alps, extend to the lime-stone soils of the high mountains of New Andalusia, and every where in America where the presence of *red sandstone* is not distinctly recognized.

IX. SANDSTONE OF BERGANTIN.

Between Nueva Barcelona and las Cerro del Bergantin (Vol. vi, p. 162) a quartzous sand-

* L. c. p. 281, 291.

† Cart von Oeyhausen, p. 258. 450 ; Charpentier, p. 444, 446.

stone covers the (jurassic) limestone of Cumanacoa. Is it an arenacious rock, analogous to *green sandstone*, or does it belong to the sandstone of Cocollar? In the latter case, its presence seems to prove still more clearly, that the limestones of Cumanaco and Caripe are only *two parts of the same system*, alternating with sandstone, sometimes quartzous, sometimes slaty.

X. GYPSUM OF THE LLANOS OF VENEZUELA.

Deposits of lamellar gypsum, containing numerous layers of marl, are found by fragments in the steppes of Caraccas and Barcelona; for instance, in the table-land of San Diego, between Ortiz and *Mesa de Paja*; near the mission of Cachipo. They appeared to me to cover the (jurassic) limestone of Tisnao, which is analagous to that of Caripe, where we find it mixed with masses of fibrous gypsum (Vol. iv, p. 386; Vol. vi, p. 49). I have not given the name of *formations*, either to the *sandstone of the Oroonoko*, or that of *Cocollar*, to the *sandstone of Bergantin*, or the *gypsum of the Llanos*, because nothing hitherto proves the *independence* of those arenacious and gypsous soils. I presume it will one day be ascertained that the gypsum of the *Llanos* covers not only the (jurassic) limestone, of the Llanos, but is

sometimes enclosed in it like the gypsum of Golfo Triste on the east of the (Alpine) limestone of Cumanacoa. Perhaps the great masses of sulphur (Vol. iii, p. 104 ; Vol. iv, p. 50, 386), found in the layers, almost entirely clayey, of the steppes (Guayuta ; valley of San Bonifacio ; Buen Pastor ; confluence of the Rio Pao with the Oroonoko), belong to the marl of the *gypsum of Ortiz*? These clayey beds are so much more worthy of the attention of travellers, since the fine observations of M. de Buch, and several other celebrated geognosts, on the *cavernosity* of gypsum, the irregularity of the inclination of its strata, and its parallel position with the two declivities of Harz, and the (heaved-up) chain of the Alps, on the simultaneous presence of sulphur, oligist iron *, and the sulphurous acid vapours which preceded the formation of sulphuric acid, seem to manifest the action of forces that reside at a great depth in the interior of the globe †.

* Gypsum with oligist iron in the variegated sandstone, south of Dax (department of the Landes).

† Leopold von Buch, *Resultate geogn. Forsch.*, 1824, p. 471-473. Friedrich Hofmann, *Beitr. zur geogn. Kenntniss von Norddeutschland*, 1822, Vol. i, p. 85, 92. Boué, *Mém. sur les terrains second. du versant nord des Alps*, p. 14. Freiesleben, *Kupferschiefer*, 1809, Vol. ii, p. 124. Boeislak, *Geol.*, Vol. i, p. 255.

XI. FORMATION OF MURIATIFEROUS CLAY (WITH BITUMEN AND LAMELLAR GYPSUM) OF THE PENINSULA OF ARAYA.

This soil presents a striking analogy with *salzthon* or *leberstein* (muriatiferous clay), which I have represented as accompanying gem-salt in every zone*. In the salt-pits of Araya (Haraia), it had attracted the attention of Peter Martyr d'Anghiera, at the beginning of the 16th century (Vol. iii, p. 204). It probably facilitated the rupture of the earth, and the formation of the gulph of Cariaco. The clay is of a smoky colour impregnated with petroleum, mingled with lamellar and lenticular gypsum, and sometimes traversed by small veins of fibrous gypsum. It incloses angular masses, and less friable, of dark brown clay, with a slaty fracture sometimes conchoid (Vol. ii, p. 266). The muriate of soda is found in parts invisible to the naked eye. The relations of position or superposition of this soil with tertiary rocks does not appear to me sufficiently clear to enable me to pronounce with certainty on this element, the most important of positive geognosy. The *co-ordinate layers of gem-salt, muriatiferous clay, and gypsum*, present the same

* Humboldt, Essai géogn., p. 241, Leonhard, Charakteristik der Felsarten, p. 362.

difficulties in both hemispheres: these masses, of which the forms are very irregular, display traces every where of great commotions. They are scarcely ever covered by *independent formations*; and after having long been believed on the continent of Europe, that gem-salt was exclusively peculiar to alpine and transition limestone, it is now still more generally admitted, either from reasonings founded on analogies, or from suppositions on the prolongation of the layers, that the real position of gem-salt is found * in variegated sandstone (*bunte sandstein*). Sometimes gem-salt appears to oscillate from variegated sandstone towards *muschelkalk*.

I made two excursions on the peninsula of Araya. In the former, I was inclined to consider the muriatiferous clay as subordinate to the agglomerate (evidently of tertiary formation) of Barignon and of the mountain of the castle of Cumana, because a little to the north

* See Kleinschrod, in *Leonh. Taschenb.* 1821, Vol. i, p. 148. Humboldt, *Essai geogn.* p. 271. Hansmann, *Jungers Flözgeb.*, p. 177. Perhaps the gem-salt oscillates from variegated sandstone, at the same time towards alpine limestone (*zechstein*), and towards *muschelkalk*. An excellent geognist, M. Oeyhausen, places it in the lower layers of *muschelkalk*. (*Karsten, Archiv.*, 1824, St. 8, p. 11). See also MM. de Decker, Oeyhausen, and la Roche in *Hertha*, B. 1, p. 27.

of that castle I had found shelves of hardened clay *, containing lamellar gypsum inclosed in tertiary soil (Vol. iii, p. 11). I believed that the muriatiferous clay might alternate with the *calcareous agglomerat of Barignon*; and near the fishers' huts situated opposite Macanao, agglomerate rocks appeared to me to pierce the strata of clay. In a second excursion to Maniquarez and the aluminiferous slates of Chaparuparu (Vol. vi, p. 93), the connexion between tertiary soil and bituminous clay, seemed to me somewhat problematical. I examined more particularly the spot of *Peñas negras* near the Cerro de la Vela, E. S. E. of the ruined castle of Araya. The limestone of the *Peñas†* is compact, of bluish grey, and almost destitute of petrifications. It appeared to me to be much more ancient than the tertiary agglomerate of Barignon, and I saw it covering in concordant position, a slaty clay, somewhat analogous to muriatiferous clay. I had a pleasure in comparing this latter formation with the layers of carburated marl contained in the alpine limestone of Cumanacoa. According to the geognostic ideas that are now the most generally spread, the rock of *Peñas Negras* may be considered as representing the *muschel-*

* Not muriatiferous, and without petroleum?

† See above Per. Nar. Vol. ii, p. 264 to 269.

kalk (limestone of Gottingue), and the saliferous and bituminous clay of Araya as representing *variegated sandstone*; but these problems can only be solved when the mines of those countries are worked. Some geognosts, who believe that the gemsalt of Italy penetrates into a soil above the jura limestone, and even chalks, may be led to take the limestone of *Peñas Negras* for one of the layers of compact limestone, destitute of grains of quartz and petrifications, which we meet with frequently amidst the tertiary agglomerate of Barignon, and of Castillo de Cumana; the saliferous clay of Araya, would appear to them analogous to the *plastic clay of Paris**, or to the clayey shelves (*dief et tourtia*) of secondary sandstone with lignites, which contain salt-springs, in Belgium and Westphalia†. However difficult it may be to distinguish *separately* the layers of marl and clay belonging to variegated sandstone, muschelkalk, quadersandstone, jurassic limestone, secondary sandstone with lignites (green and iron sand), and to the tertiary soil above chalk, I believe that the bitumen which every where accompanies gemsalt, and most

* Tertiary sandstone with lignites, or molassus of Argovia.

† Manuscript notes of MM. Dechen and Oeyhausen (*See also Buff, in Noggerath, Rheinland Westph. Vol. iii, p. 53*).

frequently salt-springs, characterizes the muriatiferous clay of the peninsula of Araya, and the island of Marguerita, as linked with formations placed below the tertiary soil. I do not say that they are *anterior* to that soil, for since the publication of M. de Buch's observations on the Tyrol, it is no longer permitted to consider what is *below*, in space, as necessarily *anterior*, relatively to the epocha of its formation.

The bitumen and petroleum still issue, as we have shewn above (Vol. ii, p. 290; Vol. vi, p. 97), from micaslate; these substances are ejected whenever the soil is shaken by a subterranean force (between Cumana, Cariaco, and the *Golfo Triste*). Now, in the peninsula of Araya, and in the island of Marguerita, saliferous clay impregnated with bitumen is fixed to this primitive soil, nearly in the same manner as gem-salt appears in Calabria by fragments in the basins, inclosed in soils of granite and gneiss *. Do these circumstances serve to support the ingenious system † according to which, all the co-ordinate formations of gypsum, sulphur, bitumen, and gem-salt (con-

* *Melograni, Descr. geologica di Aspromonte, 1823, p. 256, 276, 287.*

† *Breislak, Geologia, Vol. i, p. 350; Boué sur les Alpes, p. 17.*

stantly anhydrous) are the effect of overflowings across the crevices which have traversed the oxidated crust of our planet, and penetrated to the seat of volcanic action. The enormous masses of muriate of soda (chlorure de sodium) recently thrown up by Vesuvius *, the small veins of that salt which I have often seen traverse the most recent lithoide lavas, and of which the origin (by sublimation) appears similar to that of oligist iron deposited in the same vents †, the shelves of gem-salt and saliferous clay of the trachytic soil in the plains of Peru, and around the volcano of the Andes of Quito ‡, are well worthy the attention of geologists who would discuss the origin of formations. In the sketch which I here trace, I confine myself to the simple enumeration of the *phenomena of position*, indicating at the same time some theoretic views by which observers placed in more advantageous circumstances than I was myself, may direct their researches.

* Laugier and Gailla, in the *Annales du Mus.*, 5^e année, No. 12, p. 435. The ejected masses in 1822, were so considerable, that the inhabitants of some villages round Vesuvius, collected them for their domestic use.

† Gay-Lussac, on the action of volcanos, in the *Ann. de chimie*, Vol. xxii, p. 418.

‡ See my geogn. Essay, p. 251.

XII. AGGLOMERATE LIMESTONE OF BARIGON, THE CASTLE OF CUMANA, AND THE VICINITY OF PORTO CABELLO.

This is a very complex formation; presenting that mixture and that periodical return of compact limestone, of quarzous sandstone, and of agglomerats (limestone brechia) which peculiarly characterizes, under every zone, the tertiary soil. It forms the mountain of the castle of Saint Antonio, near the town of Cumana, the south-west extremity of the peninsula of Araya, the Cerro Meapire, south of Cariaco, and the vicinity of Porto Cabello (Vol. ii, p. 264, 290; Vol. iii, p. 10, 181, 405; Vol. iv, p. 207; Vol. vi, p. 96). It contains 1° a compact limestone, generally of a whitish grey, or yellowish white (*Cerro de Barigon*), of which some very thin shelves are entirely destitute of petrifications, while others are filled with cardites, ostracites, pectens, and vestiges of lithophyte polypieri: 2° a *brechia* in which an innumerable number of pelagic shells are found mixed with grains of quartz agglutinated by a cement of carbonate of lime; 3° a *calcareous sandstone* with very fine rounded grains of quartz (Punta Arenas, west of the village of Maniquarez), and containing masses of brown iron ore: 4° shelves of marl and slaty clay.

destitute of spangles of mica, but inclosing selenite and lamellar gypsum. These shelves of clay appeared to me to form constantly the lower layers. There also belongs to this tertiary soil, the limestone tuf (fresh water formation) of the vallies of Aragua (Vol. iv, p. 109, 186), near Victoria, and the fragmentary rock of Cabo Blanco, at the west of the port of la Guayra. I dare not designate the latter by the name of *nagelfluhe*, because that word indicates rounded fragments, while the fragments of Cabo Blanco are generally angular, and composed of gneiss, hyalin quartz, and chloritous slate, joined by a limestone cement. This cement contains magnetic sand *, madreporites, and vestiges of bivalve pelagic shells. The different fragments of tertiary soil which I found in the Cordillera of the shore of Venezuela, on the two slopes of the northern chain, seem to be superposed near Cumana (between Bordones and Punta Delgada), in the Cerro of Meapire, on the (alpine) limestone of Cumanacoa ; between Porto Cabello and the Rio Guayguaza, as well as in the vallies of Aragua, on granite ; on the western declivity of the hill formed by the Cabo Blanco, on

* The magnetic sand is no doubt owing to chloritous slate, which, in these latitudes, forms the bottom of the sea. Vol. iii, p. 404 ; Vol. vi, p. 610.

gneiss ; and in the peninsula of Araya, on saliferous clay. This latter mode of position is perhaps but a simple opposition*. If we would range the different members of the tertiary series according to the age of their formation, we ought I believe to regard the *brechia of Cabo Blanco*, with fragments of primitive rocks, as the most ancient, and make it be succeeded by the *arenacious limestone of the castle of Cumana*, destitute of horned silex, yet somewhat analogous to the (coarse) limestone of Paris, and the *fresh water soil of Victoria*. The clayey gypsum, mixed with calcareous brechia with madrepores, cardites, and oysters, which I found between Carthagera and the Cerro de la Popa, and the equally recent limestones of Guadaloupe, and Barbadoes†, (limestones filled with pelagic shells resembling those that now exist in the Caribbean sea) prove that the tertiary soil (soil of upper sediment), extends far towards the west and north.

These recent formations, so rich in vestiges of organized bodies, furnish travellers who are

* *An-nicht Auflagerung*, according to the precise language of the geognosts of my country.

† Moreau de Jonnés, *Hist. phys. des Antilles franc.*, Vol. i, p. 564. Brongniart, *Descript. géol. des environs de Paris*, 1822, p. 201.

familiarised with the zoological character of rocks, a vast field of observation. To examine these vestiges in the layers superposed as by steps, the one on the other, is to study the *Faunes of different ages*, and compare them together. The geography of animals traces the limits in space according to the diversity of climates, which determine the actual state of vegetation on our planet. The geology of organised bodies, on the contrary, is a fragment of the *history of nature*, taking the word history in its proper acceptation : it describes the inhabitants of the earth according to the succession of time. We may recognise in museums, kinds and species ; but the *Faunes of different ages*, the predominance of certain shells, the numerical relations that characterize the animal kingdom, and the vegetation of a place, or of an *epocha*, should be studied in the sight of those formations. It has long appeared to me * that in the tropics as well as in the temperate zone, univalve shells are much more numerous (in their species) than bivalves. From this superiority in number, the *organic fossil world* furnishes, in every latitude, a further analogy with the *intertropical shells* that now live at the bottom of the ocean. In fact, M.

* *Essai geogn.* p. 42.

Defrance, in a work * full of new and ingenious ideas, not only recognizes this preponderance of the univalves in the number of kinds; but also observes, that in 5500 fossil species of univalve, bivalve, and *multivalve* shells, contained in his rich collections, there are 3066 univalve, 2108 bivalve, and 326 *multivalve*; the univalve fossils are therefore to the bivalve = 3:2.

XIII. FORMATION OF PYROXENIC AMYGDALOIDE AND PHONOLITE, BETWEEN ORTIZ AND CERRO DE FLORES.

I place at the end of the formations of Venezuela the pyroxenic amygdaloide soil, and the phonolithic (*porphyrsciefer*), not as being the only rocks which I consider as pyrogenous, but as those of which the entirely volcanic origin is probably posterior to tertiary soil. This result is not owing to the observations I made at the southern declivity of the Cordillera of the shore, between the Morros of San Juan, Parapara, and the Llanos of Calabozo. In that region, local circumstances would rather lead us to regard the amygdaloides of Ortiz as linked to a system of transition rocks (amphibolic serpentine, diorite, and carburated slate

† Table of organised fossil bodies, 1824, p. 51, 125.

of Malpasso) which I described above*; but the irruption of the trachytes across rocks posterior to chalk in the Euganéés, and in other parts of Europe, joined to the phenomenon of the total absence of fragments of pyroxenic porphyry, trachyte, basalt, and phonolithe †, in the conglomerats, or fragmentary rocks anterior to the most recent tertiary soils, renders it probable that the appearance of *trapean rocks* at the surface of the soil, is the effect of one of the last revolutions of our planet, even where the irruption has taken place by crevices (veins) which cross the gneiss-granite, or transition rocks, not covered by secondary and tertiary formations.

The small volcanic soil of Ortiz, (lat. $9^{\circ} 28'$ — $9^{\circ} 36'$) forms the antient shore of the vast basin of the Llanos of Venezuela; it is composed on the points where I could examine it, of only two kinds of rocks, namely, of amygdaloide and phonolithe (Vol. iv, p. 281, &c.) The greyish blue amygdaloide contains fendilated crystals of pyroxene and mesotype. It forms

* Vol. vi, p. 613.

† The fragments of these rocks appear only in tufts, or agglomerats, which belong essentially to basaltic soil, or surround the most recent volcanos. Every volcanic formation is enveloped in *brechia*, which is the effect of the irruption itself.—*Leopold von Buch, Resultate geogn. Forsch.* p. 311.

balls with concentric layers, of which the flattened centre is nearly as hard as basalt. Neither olivine nor amphibole can be distinguished. Before it appears like an *independent* soil, and rises in small conic hills, the amygdaloide seems to alternate by layers with the diorite, which we have seen above mixed with carburated slate, and amphibolic serpentine. These close relations of rocks so different in appearance, and so fitted to embarrass the geognost, give a great interest to the vicinity of Ortiz. If the *masses* of diorite and amygdaloide which appear to us to be layers, are very large veins, they may be supposed to be formed and heaved up simultaneously. We are now acquainted with two formations of amygdaloide; one, the most common, is subordinate to basaltic soil; the other, much more rare*, belongs to pyroxenic porphyry†. The amygdaloide of Ortiz draws near, by its oryctognostic characters, to the former of those formations, and we are almost surprised to find it fixed, not to basalt, but to phonolite‡, an eminently feld-

* We find examples of the latter in Norway (Vardekullen, near Skeen), in the mountains of Thuringerwald, in South Tyrol, at Ilefeld in Harz, and at Bolanos in Mexico, &c.

† Black porphyries of M. de Buch.

‡ There are pholqnithes of basaltic soil (the most antiently known) and phonolithes of trachytic soil (Andes of Mexico). See my Geogn. Essay, p. 347. The former are

spathic rock, in which we find some crystals of amphibol, but pyroxene very rarely, and never any olivine. The Cerro of Flores is a hill covered with tabulary blocks of greenish grey phonolithe, inclosing long crystals (not fendilated), of vitrous feldspar, altogether analogous to the phonolithe of Mittelgebirge. It is surrounded by pyroxenic amygdaloide; it would no doubt be seen in the depth, issuing immediately from gneiss-granite, like the phonolithe of *Biliner Stein* in Bohemia, which contains fragments of gneiss stuck into the mass.

Does there exist in South America another groupe of rocks, designated preferably by the name of volcanic rocks, and which are as distinct from the chain of the Andes, and advance as far towards the east, as the groupe that bounds the steppes of Calabozo? Of this I doubt, at least in that part of the continent situated to the northward of the Amazon. I have often directed the attention of geognosts to the absence of pyroxenic porphyry, trachyte, basalt, and lavas (I range these formations according to their *relative age*), in the whole of America eastward of the Cordilleras. The

generally above the basalts; and the extraordinary development of feldspar in that union, and the want of pyroxene have always appeared to me very remarkable phenomena.

existence even of trachyte has not yet been verified in the *Sierra Nevada de Merida*, which links the Andes with the chain of the shore of Venezuela. It would seem as if the volcanic fire, after the formation of primitive rocks, could not pierce into eastern America (Vol. vi, p. 583). Perhaps the little wealth, and the little frequency of argentiferous veins observed in those countries, arises from the absence of more recent volcanic phenomena*. M. d'Eschwege saw at Brazil, some layers (veins?) of diorite, but neither trachyte, basalt, dolerite, nor amygdaloide; and he was therefore more surprised to see, in the vicinity of Rio Janeiro, an insulated mass of phonolithe, entirely similar to that of Bohemia, pierce the gneiss soil†. I am inclined to believe that America, on the east of the Andes, would have burning volcanos if, near the shore of Venezuela, Guyana, and Brazil, the series of primitive rocks were interrupted trachytes. The trachytes, by their fendillation, and open crevices, seem to establish that permanent communication between the surface of the soil and the interior of the globe, which is the indispensable condition of the existence of a volcano. If we direct our course from the coast of Paria, by the gneiss-granite

* See my geogn. Essay, p. 118, 120.

† Manuscript notes of Baron d'Eschwege.

of the Silla of Caraccas, by the red sandstone of Barquisimeto and Tocuyo, the slaty mountains of the Sierra Nevada de Merida, and the eastern Cordillera of Cundinamarca, to Popayan and Pasto, taking the *rumb* of the west and south-west, we find in the vicinity of those towns the first volcanic mouths of the Andes, still burning, those which are the most northerly of all South America; it may be added, that those craters are found where the Cordilleras begin to furnish trachytes at a distance of 18 or 25 leagues from the actual coast of the Pacific Ocean*. Permanent communications, or at least such as are frequently renewed, between the atmosphere and the interior of the globe, have only been preserved along that immense crevice on which the Cordilleras have been heaped up; but the subterranean volcanic forces do not display less activity in eastern America, in shaking the soil of the Cordillera of the shore of Venezuela, and of the groupe of Parime†. In describing the phenomena which

* I believe the first hypotheses on the relation between the burning of volcanoes, and the proximity of the sea, are found in a very eloquent work, little known, of Cardinal Bembo: *Ætna dialogus* (See *Opera omnia Petr. Bembi*, Vol. iii, p. 60); and in *Vicenti Aliarii Crucii Vesuvius ardens*, 1632, p. 164 and 235).

† See the classical work of M. de Hoff, on the spheres of oscillations, and the limits of earthquakes, bearing the title :

accompanied the great earthquake of Caraccas*, the 26th March, 1812, I mentioned the detonations which were heard at different periods, in the mountains, altogether granitic, of the Oroonoko. The elastic forces which agitate the soil, the still-burning volcanos, the hot sulphurous springs, sometimes containing fluoric acid, the presence of asphaltum and naphtha in primitive soils, all lead us towards the interior of our planet, of which the high temperature is

Geschichte der nat. Veränderungen der Erdoberfläche, 1824, Vol. ii, p. 516.

* I stated in another place the influence which this great catastrophe exerted on the counter-revolution which the royalist party succeeded in producing at this epocha in Venezuela. Nothing is more curious than the negociation which was opened on the 5th of April, by the republican government, placed at Valencia in the vallies of Aragua, with Archbishop Prat (Don Narciso Coll y Prat), to engage him to publish a pastoral letter fitted to tranquillize the people respecting the wrath of the divinity. The Archbishop was permitted to say that this wrath was merited on account of the disorder of morals; but he was enjoined to declare positively, that politics and systematic opinions on the new social order had nothing in common with it; (*declarar que la justicia divina a los mas ha querido castigar a los vicios morales, sin que el terremoto tenga conexion alguna con los sistemas y reformas politicas de Venezuela*). Archbishop Prat lost his liberty after this singular correspondence. See the official documents, published in *Pedro de Urquinaona, Relacion documentada del origen y progresos del trastorno de las provincias de Venezuela, 1820, Vol. i, p. 72—83*).

felt even in our mines of the least depth, and which since Heraclitus of Ephesus, and Anaxagoras of Clazomane, to the Plutonism of modern times, has been considered as the seat of the great agitations of the globe.

The sketch I have just traced furnishes all the *formations* we know in that part of Europe, which has served as the type of positive geognosy. It is the fruit of a labour of sixteen months, often interrupted by other occupations. The formations of quartziferous porphyry, pyroxenic porphyry and trachyte, of grauwacke, muschelkalk, and quadersandstein, which are frequent towards the west, have not yet been recognized in Venezuela; but it may be also observed that, in the system of secondary rocks of the antient continent, muschelkalk and quadersandstein are not always clearly developed, and are often by the frequency of their marls, confounded with the lower shelves of jurassic limestone. The muschelkalk is almost a lias* with encrinite, and quadersandstone (for there are doubtless many above the lias or limestones with gryphites) seems to me to *represent* the arenacious layers of the lower shelves of jurassic limestone. I thought it my duty to give an extensive developement to the

* See the judicious reflexions of M. Boué, in his Memoir on the Alps, p. 24.

geognostic description of South America, not only on account of the interest of novelty which the study of the *formations* in the equinoxial regions excites, but also on account of the honorable efforts which have recently been made in Europe to verify and extend the working of the mines in the Cordilleras of Columbia, Mexico, Chili, and Buenos Ayres. Great capitals have been formed to attain this useful end. In proportion as public confidence has enlarged and consolidated those enterprizes, from which both continents may derive such solid advantages, it becomes the duty of those who have acquired a local knowledge of these countries, to publish the materials that are fitted to give a just appreciation of the relative riches and position of the ore-mines in different parts of Spanish America. The success of *the association for the working of mines*, and that of the labors undertaken by the order of free governments, is far from depending solely on the improvement of the machines employed for draining off the waters, and extracting the mineral, on the regular and economical distribution of the *subterraneous works*, or the ameliorations of *preparation, amalgamation, and melting*; the success depends also on a thorough knowledge of the different *superposed soils*. The practice of the art of the miner is closely linked with the progress of geognosy; and it may be proved

that several millions of piastres have been rashly expended in South America, from a complete ignorance of the nature of the *formations*, and the position of the rocks, in directing the *labors of research*. It is not solely the precious metals which should now fix the attention of the new *associations of mines*; the multiplication of steam-engines, renders it indispensable, wherever wood is not abundant, or of easy transport, to seek at the same time to discover *coal and lignites*. In this point of view, the precise knowledge of red sandstone, or coal-sandstone, quadersandstein and molassus (tertiary formation of lignites), often covered with basalt and dolerite, is of great practical importance. It would be difficult for a European miner, recently disembarked, to judge of a country with a new aspect, and when the same formations cover an immense space. I flatter myself that the work I now publish, as well as my *Political Essay on New Spain*, and my work on the *Position of rocks in the two hemispheres*, will contribute to diminish those obstacles. They may be said to contain the *first geognostic knowledge* of places of which the subterraneous wealth attracts the attention of commercial nations, and they will serve to class the more precise notions which ulterior researches will add to my labors.

The republic of Colombia in its present li-

mits, furnishes a vast field to the enterprising spirit of the miner. Gold, platina, silver, mercury, copper, gem-salt, sulphur, and alum, may become objects of important workings. The production of gold alone amounted before the epocha of the civil dissensions *, mean year, to 4700 kilogrammes (20,500 marks of Castille). This is nearly half the quantity furnished by all Spanish America, a quantity which has an influence so much more powerful on the variable proportions between the value of gold and silver, that the extraction of the former metal has diminished at Brazil, during forty years past, with surprising rapidity. The *quint* (a tax which the government raises on gold-washings), and which in the Capitania of Minas Geraes, was, in 1756, 1761, and 1767, from 118, 102, and 85 arobas of gold (at 14 $\frac{1}{2}$ kilogrammes), is fallen, according to manuscript notes kindly furnished me by the Baron d'Eschwege, director-general of the mines of Brazil, in 1800, 1813, and 1818, to 30, 20, and 9 arobas; an arob of gold having at Rio Janeiro, the value of 15,000 cruzades. According to these estimations, the ancient produce of the gold of Brazil, making deductions for fraudulent exportation, was in the middle of the 18th century, in the years of the greatest wealth of the

* See my Political Essay, Vol. iii, p. 394.

gold-washings, 6600 kilogrammes, and in our days, from 1817 to 1820, 600 kilogrammes less. In the province of Saint Paul, the extraction of gold has entirely ceased; in that of Goyaz, it was 803 kilogrammes in 1793, and in 1819 scarcely 75. In the province of Mato Grosso it is almost nothing; and M. d'Eschwege thinks that the whole produce of the gold of Brazil does not amount at present, to more than 600,000 cruzades (scarcely 440 kilogrammes). I dwell on these precise results, because, in confounding the different epochas of the riches and poverty of the *washings* of Brazil, it is still affirmed in all the works that treat of the commerce of precious metals, that a quantity of gold equivalent to four millions of piastres, that is 5800 kilogrammes of gold *, flows into

* The error is double, (*Eschwege, Journal von Brasilien*, Vol. i, p. 218); it is probable that Brazilian gold, *paying the quint*, has not during forty years past, risen to 5500 kilogrammes. I heretofore shared this error with all the writers on political economy, in admitting, from a memoir of M. Correa de Serra, otherwise highly instructive, that the quint in 1810, was still (instead of 26 arrobas or 379 kil.) 51,200 Portuguese ounces, or 1433 kil.; which supposed a product of 7165 kil. (*See my Pol. Essay*, Vol. iii, p. 394. *Malte Brun, Geogr.* Vol. v, p. 675. *Lowe, present State of England*, 1822, p. 267.) The very exact information given from two Portuguese manuscripts on the *gold washings* of Minas Geraes, Minas Novas, and Goyaz, in the Bullion Report for the House of Commons, 1810, acc. p. 29, goes as far

Europe annually, from Portugueze America. If, in commercial value, gold in grains prevails in the republic of Columbia over the value of other metals, the latter are not on that account less worthy to fix the attention of government, and individuals. The argentiferous mines of Saint Anne, to Manta, Santo Christo de las Laxas, Pamplona, Sapo, and la Vega de Sapia, give rise to great hopes. The rapidity of the communications between the coast of Colum-

only as 1794, when the *quinto do ouro* of Brazil was 53 arrobas, which indicates a product of more than 3900 kil. *paying the quint*. In the important work of Mr. Tooke (*on high and low prices*, P. II, p. 2), this product is still estimated, mean year (1810—1821), according to Mr. Jacob, at 1,736,000 piastres ; while, according to official documents in my possession, the mean of the quint of those ten years amounts only to 15 arrobas, or a product *quint* of 1095 kilogrammes, or 755,000 piastres. Mr. John Allen had already reminded the *Committee of the Bullion Report*, in his critical notes on the table of M. Brongniart, that the decrease of the product of the gold-washings of Brazil had been extremely rapid since 1794 (*Report*, p. 44) ; and the notions given by M. Auguste de Saint Hilaire indicate the same desertion of the gold-mines of Brazil. The antient miners become cultivators (*Hist of the most remarkable plants of Brazil and Paraguay*, 1824, Introd., p. 9, and 32). The value of an arroba of gold is 15,000 cruzades of Brazil, (each cruzade being 50 sols.) According to M. Franzini, the the Portugueze onça is equal to 0,028 kil., and 8 onças make 1 mark ; 2 marks make 1 arratel, and 32 arratels make 1 arroba.

bia, and that of Europe, gives the same interest to the copper-mines of Venezuela, and New Grenada. Metals are a merchandize purchased at the price of labour, and an advance of capital; in the countries where they are produced they form a part of commercial wealth, and their extraction vivifies industry in the most barren and mountainous soils. The profits of mines being from their nature often irregular, and as an interruption in the subterranean labors, while it causes an irreparable loss, shackles the plans of a prudent administration, the *system of association* now applied in England to the metallic riches of the New World, will produce the most happy effects, if these *associations* are of long duration, and if the men invested with their confidence, unite, with the practical knowledge of the art of the miner, that of mechanics and modern chemistry; and do not disdain to avail themselves of the light spread in America among men who have followed the labors of working and amalgamation; finally, if they know how to guard against those illusions which the exaggerated hope of gain never fails to excite.

In the map of Columbia which I now publish (March, 1825), the limits are indicated such as they were when the congress, conform-

ably to the 85th and 93d articles of the Constitution, fixed the division into departments and provinces, estimating at the same time the respective population on which the number of representatives depends. These official estimates for the eight departments of the Orinoko (175,000); of Venezuela (430,000); of Zulia (162,000); of Boyaca (444,000); of Cundinamarca (371,000); of Cauca (191,000); of Magdalena (239,300); and of Guayaquil (90,000), nearly such as I stated above (Vol. vi, p. 135), according to the *Gazette of Columbia*, of February 10th, 1822; but they differ a little for the departments of Quito (516,071), and of Ystmo (90,825). The former comprehended in 1822, seven provinces; namely, Quito, Quixos, and Macas (together, 354,748); Jaen (9,000); Maynas (36,000); Cuenca (89,343); Loxa (26,980). The department of the Ystmo is divided into two provinces: namely, Panama (58,625), and Veragua (32,200): total of Columbia, 2,711,296. This official estimate, *founded on no direct numbering*, coincides within nearly 1-57th with that on which I had fixed. According to a recent decree of the congress of Bogota (of the 23d June, 1824), the territory of the republic of Columbia is composed of twelve departments, comprehending altogether thirty-eight provinces, namely; 1. *Orinoco* (principal seat, Cumana), di-

vided into four provinces : Cumana, Barcelona, Marguerita, and Guyana. 2. *Venezuela* (principal city, Caraccas), divided into two provinces : Caraccas, and Carabobo. 3. *Apure* (principal town, Varinas), divided into two provinces : Varinas and Apure. 4. *Zulia* (principal city, Maracaibo), divided into four provinces : Maracaibo, Coro, Merida, and Truxillo. 5. *Boyaca* (principal town, Tunja), divided into four provinces : Tunja, Pamplona, Socorro, Casanare. 6. *Cundinamarca* (principal place, Bogota, the antient residence of the viceroy of the *New Kingdom of Grenada*, and not the village of Bogota, now called Funsa) ; this department is divided into four provinces : Bogota, Antioquia, Mariquita, and Neiva. 7. *Magdalena* (principal place, Cartagena), divided into three provinces : Cartagena, S. Marta, and Rio Hacha. 8. *Cauca* (principal place, Popayan), divided into four provinces : Popayan, Choco, Pasto, and Buenaventura. 9. *Ystmo* (principal place, Panama), divided into two provinces : Panama and Veragua. 10. *The Equator, departamento del Ecuador* (principal place, Quito), divided into three provinces : Pichincha, Imbubura, and Chimborazo. 11. *Assuay* (principal place, Cuenca), divided into four provinces : Cuenca, Loxa, Jaen, and Maynas. 12. *Guayaquil* (principal place, Guayaquil), divided into two provinces : Guayaquil and Ma-

nabi. Before the revolution of the colonies, the whole coast of the Mosquitos, from Cape Gracias a Dios to the Rio Chagre, comprehending the Island San Andres, had been separated, by the royal cedula of the 30th November, 1803, from the Capitania general of Guatimala, and added to New Grenada. We find, for the mean extent of a department of Columbia, 7700 square marine leagues; for the mean extent of a province, 2400 square leagues; one of the twelve new departments of Columbia consequently exceeds in extent thirty-three times, and one of the thirty-eight provinces twelve times a department of France (Vol. vi, p. 187). The mean population of a department of Columbia, of which the surface is equal to twice that of Portugal, is 232,000 souls, that is, half less than the mean population of a department of France. Venezuela, that is the antient Capitania general of Caraccas, has nearly half the surface of the actual presidency of Bengal, but its *relative population* is thirty-six times less. Nothing is more striking than this difference between the antient civilization of India, and those countries of South America where mankind appears to be a colony recently established. In the tables of population of the fine map of Indostan, published by Mr. Carey, in 1824, under the auspices of Colonel Valentine Blacker, chief of the geographical engineers at

Calcutta, the English possessions, and of the allies of Great Britain, are estimated at 123,000,000 ; namely : British territory in India, eighty-three millions ; allies and tributaries, forty millions. The states which I had considered above (Vol. vi, p. 336) with Mr. Hamilton, as being independent, are become allies of the company.

STATEMENT OF THE HEIGHTS OF THE MOST REMARKABLE PLACES
OF VENEZUELA ABOVE THE LEVEL OF THE SEA.

| NAMES OF PLACES. | Height intoises. | NAMES OF THE OBSERVERS, AND VARIATIONS. |
|--|---------------------|--|
| ROAD FROM LA GUAYRA TO CARACAS : | | |
| Maiqueti, at the entrance of the street that leads to Caraccas | 13 | The whole leveling of the road is indicated in this table from M.M. Boussingault & Rivero. |
| Curucuti - - - | 320 | |
| El Salto, antient fort - | 479 | Profil (Pl. IV, 465 t.) |
| La Venta - - - | 622 | (Humboldt, 606 t.) |
| La Cumbre, the highest part of the road - | 764 | Ht., 763 t. |
| Caraccas, in the middle of the street of Carabobo - | 477 | Ht., at the great square, 446 t. |
| Eastern Peak of the Silla of Caraccas - - - | 350 | Humboldt, Jan. 3d, 1800; Boussingault and Rivero, (Jan. 12th, 1823), 1351 toises. |
| ROAD FROM CARACAS TO MERIDA : | | |
| Hill of Buenavista - - - | 835 | Humboldt. |
| Village of San Pedro - | 584 | Ht. (Boussingault and Rivero, 590 t.) |
| Maracay in the vallies of Aragua - - - | 223 | B. and R. |
| La Victoria - - - | 270 | Ht. (B. and R. 284 t.) |
| Nueva Valencia - - - | 234 | Ht. (B. and R. 247 t.) |
| Villa of Cura - - - | 266 | Humb. |
| San Carlos - - - | 85 | B. and R. |
| Calabozo (the small table-land, mesa in the Llanos - | 94 | Ht. |
| Barquisimeto - - - | 76 | B. and R. |
| Tocuyo - - - | 322 | B. and R. |
| Truxillo - - - | 420 | B. and R. |
| Merida - - - | 826 | B. and R. |
| Paramo of Mucuchies, limited to Sierra Nevada de Merida | 2120 | B. and R. |
| MOUNTAINS OF NEW ANDALUSIA : | | |
| Cumana - - - | 3 | Humboldt. |
| Cerro del Impossible - | 297 | Ht. |
| Cumanacoa - - - | 104 | Ht. |
| Table land of Cocollar - | 408 | Ht. |
| Summit of Turimiquiri - | 1050 | Ht., a little doubtful, trigon. mea. |
| Cuchilla of Guanaguana - | 543 | Ht. |
| Convent of Caripe - | 412 | Ht. |
| Table-land of Guarda of San Augustin - - - | 533 | Ht. |
| Catuaro - - - | 190 | Ht. |
| SIERRA PARIME and the banks of the Oroonoko and the Rio Negro : | | |
| Soil of the forests round Javita and the Esmeralda - | 180 | Ht. |
| The Peak of Duida - - | 1300 | Ht. (trigonometrical measure.) |
| Fort of San Carlos del Rio Negro - - - | 127 | Ht., a little doubtful. |

The barometrical survey, of which I gave the results in my Collection of Astronomical Observations (Vol. i, p. 295—298), has been recently rectified and extended by two travellers well versed in every branch of the physical sciences, MM. Boussingault and Rivero. Wherever my early results differed from theirs, I have given the preference to the latter. M. Boussingault has transmitted the detail of his measurements to the Institute of France. It must not be forgotten, that in my profil of the road from La Guayra to Caraccas (Pl. iv.) published in 1817, the heights of Torrequemada, Curucuti, and Puente del Salto, are simply founded on approximative estimates, and not on real measures. (*Per. Nar.*, Vol. iii, p. 409.) At Salto, la Venta, and Cumbre, M. Boussingault's results and mine differ but little; in the measurement of la Silla, which is the loftiest mountain of those countries, the agreement (accidentally no doubt), is within one toise; but in the town of Caraccas my heights appears less faulty. I believed the custom-house to be 491 toises; the barracks, 462 t.; the Trinity, 454 t.; the great square, 446. According to MM. Boussingault and Rivero, who are furnished with excellent barometers of Fortin, the middle of the street of Carabobo is 477 toises above the level of the sea. We did not measure at the same parts of the town, and modern travellers give

the banks of Rio Guayre 406 t., while (if there is no incorrectness of cyphers in my journal) I found the height 414 t. near la Noria (*See above*, Vol. iii, p. 449). In this uncertainty respecting the partial results, I have confined myself to the indication in the preceding table, for the town of Caraccas, of the *level of the street of Carabobo*. The agreement of my observations with those of MM. Rivero and Boussingault, in the vallies of Aragua, is very satisfactory, for the latitudes, as well as for the heights.

Observations made to verify the progress of the horary variations of the barometer in the tropics, from the level of the sea, to the ridge of the Cordillera of the Andes.

The results of M. Bonpland's observations and mine on the small *atmospheric tides*, during our stay at Cumana, Caraccas, in the steppes of Calabozo, and amidst the forests of the Oroonoko, were published in 1800 and 1801, by M. de Lalande, to whom I had communicated them successively. I flatter myself that this labor has greatly contributed to fix the attention of naturalists in Europe on a very curious phenomenon, of which the cause is not yet completely ascertained. The regularity of the horary variations of the barometer, in the torrid

zone, had been conjectured from the beginning of the 18th century ; and the questions which the Academy of Science addressed to M. de la Perouse * tended to explain the part which the attraction of the moon might have in these periodical changes. MM. de Lamanon and Monges made, in 1785, a series of very valuable observations in the Atlantic Ocean, lat. $1^{\circ} 5'$ N. and $1^{\circ} 34'$ S., during three days and three nights, from hour to hour, at a season when the temperature did not change from night to day $1\frac{1}{2}^{\circ}$ Reaum.: but it remained to verify the uniformity of the progress of the barometer in the interior of the continents, in changeable weather, at various heights above the level of the sea. The solution of those problems was the object of a study which I pursued with the greatest care during four years, north and south of the equator, in the plains and on the tablelands of the Cordilleras, at the height of from 1800 to 2100 toises. As no other naturalist has hitherto had the facility of devoting himself to those researches on a *scale of height* so considerable, I shall insert by degrees, in this work, an extract of my horary observations. In order to give more interest to those I made at Venezuela, I have added the barometrical

* *Voyage de la Perouse autour du monde*, Vol. i, p. 161 ; Vol. iv, p. 257.

heights of Lima, in the southern hemisphere ; of Sierra Leone ; and of the southern table-land of India. The following tables furnish the horary variations of the shore of Cumana, La Guayra, Peru, the coast of Africa, and the Isle Taiti ; those of Mysore (400 t.) ; of the valley of Caraccas (480 t.) ; of Ibague, in New Grenada, at the foot of the Andes of Quindiu (703 t.) ; of Popayan (911 t.) ; of Mexico (1168 t.) ; and of Quito (1492 t.). All these observations are unpublished, with the exception of those of Captain Sabine, which I borrowed from the excellent Meteorology of M. Daniell (*His. Essays*, 1823, p. 254).

HORARY VARIATIONS AT CUMANA, NOR. LAT. $10^{\circ} 27' 52''$;
HEIGHT, 15 TOISES. (*Observations of MM. Humboldt and Bonpland.*)

| JULY 1799. | | | | JULY 1799. | | | |
|------------------------------|------|--------|------------------------|---|------|--------|---------|
| The 17 at 20 $\frac{1}{2}$ h | Bar. | 337.57 | Th. 16° | The 22 at 20h | Bar. | 337.43 | Th. 18° |
| + 21 | | 337.62 | | + 21 | | 337.62 | |
| 18 at 0 | | 337.54 | | 23 at 1 | | 337.54 | |
| 2 | | 337.12 | Th. 23° | 3 | | 337.21 | Th. 23° |
| 3 | | 336.74 | | — 4 | | 337.03 | |
| — 3 $\frac{1}{2}$ | | 336.52 | | 5 | | 337.14 | |
| 6 | | 336.83 | Th. 21° | 7 $\frac{1}{2}$ | | 337.32 | |
| 7 $\frac{1}{2}$ | | 337.24 | | 10 | | 337.53 | |
| 9 | | 337.75 | | + 11 | | 337.61 | Th. 18° |
| + 11 | | 337.90 | | 11 $\frac{1}{2}$ | | 337.45 | |
| 14 | | 337.21 | Th. 18 $\frac{1}{2}$ ° | AUGUST 1799. | | | |
| 18 $\frac{1}{2}$ | | 337.62 | | 16 at 18h | Bar. | 336.62 | Th. 18° |
| + 21 | | 337.71 | Th. 20° | + 21 | | 337.20 | |
| 19 at 1 | | 337.69 | | 21 $\frac{1}{2}$ | | 337.10 | Th. 22° |
| 2 | | 336.81 | Th. 22° | 22 | | 337.02 | |
| 3 $\frac{1}{2}$ | | 336.62 | | 23 | | 336.80 | |
| — 4 | | 336.53 | | 17 at 0 | | 336.73 | |
| 5 $\frac{1}{2}$ | | 336.76 | Th. 21° | 1 | | 336.20 | |
| + 11 | | 337.79 | | 2 $\frac{1}{2}$ | | 336.10 | Th. 23° |
| 12 | | 337.51 | Th. 18° | 3 | | 336.02 | |
| 19 | | 337.7 | | — 4 | | 335.90 | |
| 20 $\frac{1}{2}$ | | 338.14 | Th. 22° | 6 | | 336.12 | Th. 19° |
| + 21 $\frac{1}{2}$ | | 338.42 | | 8 | | 336.40 | |
| 23 $\frac{1}{2}$ | | 337.93 | | 9 $\frac{1}{2}$ | | 336.63 | |
| 20 at 2 | | 337.32 | Th. 24° | 10 $\frac{1}{2}$ | | 336.70 | |
| — 4 | | 336.80 | | + 11 | | 336.82 | |
| 10 $\frac{1}{2}$ | | 337.74 | Th. 19° | 13 | | 336.51 | Th. 18° |
| + 11 | | 337.90 | | 18 $\frac{1}{2}$ | | 336.25 | |
| 13 | | 337.31 | Th. 18° | 20 $\frac{1}{2}$ | | 336.81 | Th. 19° |
| 19 $\frac{1}{2}$ | | 337.40 | | + 21 | | 336.85 | |
| + 21 | | 337.63 | | 23 $\frac{1}{2}$ | | 336.70 | |
| 21 at 1 | | 337.23 | Th. 23° | 18 at 0 $\frac{1}{2}$ | | 336.51 | |
| 3 | | 337.04 | | 2 | | 336.27 | |
| — 4 | | 336.83 | | — 4 | | 335.92 | Th. 21° |
| 9 $\frac{1}{2}$ | | 337.25 | | 8 | | 336.34 | |
| + 11 | | 337.81 | Th. 19° | From the 18th to the 24th of July, regularly at two o'clock, a storm, blowing from south-east to south, along the mountains. On the 18th of Au- gust, eleven shocks of an earthquake were felt at Carupano. The hygrome- ter of Deluc, in the morning, 60° to 58°; in the afternoon, 48° to 50°. | | | |
| 12 | | 337.64 | | | | | |
| 18 $\frac{1}{2}$ | | 337.24 | Th. 20° | | | | |
| + 21 $\frac{1}{2}$ | | 337.82 | | | | | |
| 22 at 0 | | 337.75 | | | | | |
| 3 | | 337.21 | Th. 23° | | | | |
| — 4 | | 336.95 | | | | | |
| 6 $\frac{1}{2}$ | | 337.32 | | | | | |
| 10 $\frac{1}{2}$ | | 337.64 | | | | | |
| + 11 | | 337.71 | Th. 18° | | | | |
| 13 | | 337.52 | | | | | |

HORARY VARIATIONS AT CUMANA, HEIGHT, 15 TOISES. (*Continuation.*)

| AUGUST 1799. | | | | AUGUST 1799. | | | |
|---------------------------|--------|---------|--|---------------------------|--------|---------|--|
| The 18 at 11 ^h | Bar. | 336.75 | | The 23 at 20 ^h | Bar. | 336.70 | |
| 12 | 336.71 | Th. 18° | | + 21 $\frac{1}{2}$ | 336.80 | Th. 21° | |
| 18 | 336.75 | | | 22 $\frac{1}{2}$ | 337.00 | | |
| 20 | 336.94 | | | 23 $\frac{1}{2}$ | 336.90 | | |
| + 21 | 337.12 | Th. 21° | | 24 at 1 | 336.70 | | |
| 22 | 337.07 | | | 2 | 336.30 | | |
| 23 | 337.07 | | | - 2 $\frac{1}{2}$ | 336.52 | Th. 23° | |
| 19 at 0 | 337.00 | | | 5 | 336.40 | | |
| 2 | 336.65 | Th. 23° | | 7 $\frac{1}{2}$ | 336.70 | | |
| 3 | 336.45 | | | 9 | 336.95 | Th. 23° | |
| 3 $\frac{1}{2}$ | 336.30 | | | + 11 | 337.05 | | |
| - 4 | 336.24 | | | 23 | 337.00 | | |
| 5 | 336.32 | | | 25 at 2 | 336.90 | | |
| 6 $\frac{1}{2}$ | 336.37 | | | - 4 | 336.80 | Th. 23° | |
| 10 | 336.80 | | | 5 | 336.80 | | |
| + 11 | 336.95 | Th. 19° | | 7 | 336.80 | | |
| 12 | 336.84 | | | + 10 | 337.00 | | |
| 21 at 18 $\frac{1}{2}$ | 336.68 | Th. 18° | | 12 | 336.90 | Th. 18° | |
| + 21 | 337.12 | | | 13 | 336.84 | | |
| 22 | 337.05 | | | 20 | 337.41 | | |
| 22 at 1 | 336.80 | | | + 21 | 337.50 | | |
| 2 | 336.60 | Th. 23° | | 22 | 337.40 | | |
| 3 | 336.40 | | | 23 | 337.23 | | |
| - 4 | 336.40 | | | 26 at 0 | 337.05 | Th. 23° | |
| 7 $\frac{1}{2}$ | 336.52 | | | 0 $\frac{1}{2}$ | 336.70 | | |
| 10 $\frac{1}{2}$ | 336.68 | | | 1 | 336.75 | | |
| + 11 | 336.75 | | | 3 | 336.45 | | |
| 12 | 336.65 | | | - 4 | 336.40 | | |
| 15 | 336.50 | | | 5 | 336.40 | Th. 22° | |
| - 16 $\frac{1}{2}$ | 336.40 | Th. 17° | | 7 | 336.50 | | |
| 17 | 336.53 | | | 10 $\frac{1}{2}$ | 337.10 | | |
| + 21 | 337.10 | | | + 11 | 337.25 | Th. 18° | |
| 22 | 337.05 | | | 13 | 337.08 | | |
| 23 | 336.90 | | | 20 $\frac{1}{2}$ | 337.10 | | |
| 23 at 0 | 336.85 | Th. 22° | | + 21 | 337.18 | Th. 19° | |
| 1 | 336.70 | | | 23 $\frac{1}{2}$ | 337.18 | | |
| 3 $\frac{1}{2}$ | 336.00 | | | 27 at 0 $\frac{1}{2}$ | 337.05 | | |
| - 4 | 336.00 | | | 1 | 336.82 | | |
| 5 | 336.13 | | | 2 | 336.80 | Th. 23° | |
| 7 $\frac{1}{2}$ | 336.50 | | | | | | |
| 9 | 336.65 | | | | | | |
| 10 $\frac{1}{2}$ | 336.80 | | | | | | |
| + 11 | 336.85 | Th. 19° | | | | | |
| 12 | 336.50 | | | | | | |
| - 15 | 336.50 | | | | | | |
| 16 $\frac{1}{2}$ | 336.55 | | | | | | |
| 19 | 336.53 | | | | | | |

The 24th and 30th August, furious electric storms appear to have interrupted during some instants, the movement of the barometer. The instrument retrograded on the 24th and the 30th, at the same hour at half past 2 in the afternoon.

HORARY VARIATIONS AT CUMANA, HEIGHT 15 TOISES. (*Continuation.*)

| AUGUST 1799. | | | AUGUST 1799. | | |
|--------------------------|-------------|-----------|--|-------------|-----------|
| The 27 at—4 ^h | Bar. 336.51 | | The 28 at 23 ^½ ^h | Bar. 336.76 | |
| 5 ^½ | 336.53 | | 29 at 0 | 336.50 | Th. 24,5° |
| 6 ^½ | 336.59 | | 2 | 336.25 | |
| 8 ^½ | 336.75 | | — 4 | 335.75 | |
| + 11 | 336.83 | | 4 ^½ | 335.78 | |
| 12 | 336.80 | Th. 17,5° | 6 ^½ | 336.05 | Th. 19,7° |
| 16 | 336.75 | | 10 ^½ | 336.52 | |
| 16 ^½ | 336.70 | | + 11 | 336.57 | |
| 17 | 336.90 | | 12 | 336.40 | Th. 18,2° |
| 19 ^½ | 337.18 | | 16 | 335.72 | |
| 21 | 337.20 | | — 19 ^½ | 336.17 | Th. 21° |
| + 23 | 336.95 | | 20 | 336.25 | |
| 28 at 0 ^½ | 336.70 | Th. 25,5° | + 21 | 336.75 | |
| 1 | 336.62 | | 21 ^½ | 336.70 | |
| 2 ^½ | 336.29 | | 22 | 336.60 | |
| 3 ^½ | 336.18 | Th. 25,7° | 30 at 2 | 336.60 | Th. 24° |
| — 4 | 336.15 | | 2 ^½ | 336.75 | |
| 4 ^½ | 336.25 | | — 4 | 335.72 | |
| 7 | 336.60 | Th. 18° | 5 ^½ | 335.74 | |
| + 11 | 336.50 | | 8 ^½ | 336.25 | |
| 12 | 336.40 | | + 11 | 336.50 | Th. 19° |
| + 21 | 337.27 | | | | |

HORARY VARIATIONS AT CUMANA, HEIGHT, 10 TOISES. (*Continuation.*)

| NOVEMBER 1799. | | | NOVEMBER 1799. | | |
|--|-------------|--|---------------------------|-------------|--|
| The 3d at 20 ^½ ^h | Bar. 336.80 | | The 5 at +11 ^h | Bar. 336.86 | |
| + 21 | 336.83 | | 13 | 336.32 | |
| 4 at 1 | 336.04 | | — 16 ^½ | 336.28 | |
| — 4 ^½ | 335.92 | | 20 | 337.30 | |
| 10 | 336.20 | | + 21 | 337.64 | |
| + 11 | 336.42 | | 21 ^½ | 337.76 | |
| 12 | 336.26 | | 6 at 0 | 336.47 | |
| 15 | 336.02 | | 3 | 336.24 | |
| — 16 | 335.90 | | — 4 | 336.28 | |
| 20 | 336.94 | | 5 | 336.32 | |
| + 21 | 337.02 | | 8 ^½ | 336.63 | |
| 22 | 337.00 | | + 11 | 336.90 | |
| 5 at 1 | 336.72 | | 13 | 336.52 | |
| 3 | 336.25 | | — 16 | 335.95 | |
| — 4 | 336.20 | | 18 | 336.70 | |
| 4 ^½ | 336.52 | | + 21 | 337.34 | |

On the 4th of November, at 4h 12' in the afternoon, a violent shock of an earthquake took place. (See above, Vol. iii, p. 315, 316.) Thermometer in all the observations at Cumana, at the division of Reaumur.

HORARY VARIATIONS AT LA GUAYRA, NOR. LAT. 10° 36' 19''; HEIGHT,
5 TOISES. (*Observations of MM. Boussingault and Rivero.*)

| NOVEMBER. | | | | | NOVEMBER. | | | | |
|-----------|--------|-----------|-----------------|-------|-----------|--------|-----------|-----------------|-------|
| Days | Hours. | Millimet. | Therm. cent. | Hygr. | Days. | Hours. | Millimet. | Therm. cent. | Hygr. |
| 23 | 8 | 763.65 | 25.0 | 88 | | 7 | 762.20 | 27.0 | 92 |
| | 9 | 763.80 | 25.3 | 86 | | 8 | 763.0 | 27.0 | 91 |
| + | 10 | 764.0 | 25.8 | 87 | + | 9 | 763.55 | 26.5 | 90 |
| | 11 | 764.0 | 27.0 | 90 | | 10 | 763.35 | 26.3 | 87 |
| | noon | 763.35 | 28.1 | 90 | | 11 | 763.15 | 26.0 | 86 |
| | 1 | 762.75 | 28.5 | 89 | | midnt. | 763.05 | 25.3 | 85 |
| | 2 | 762.35 | 28.8 | 88 | | | | | |
| | 3 | 761.95 | 28.8 | 90 | | | | | |
| - | 4 | 761.70 | 28.0 | 91 | | | | | |
| | 5 | 761.75 | 27.3 | 91 | | | | | |
| | 6 | 762.75 | 27.4 | 93 | | | | | |

From 8 o'clock in the morning till mid-
night. These observations were made with
an excellent barometer of Fortin. Ther-
mometer centesimal. Hygr. of Saussure.

HORARY VARIATIONS AT LA GUAYRA, HEIGHT 5 TOISES. (*Continuation*)

| NOVEMBER 1822. | | | | | | NOVEMBER 1822. | | | | | |
|----------------|--------|-----------|-----------------|-------|----------------------|----------------|--------|-----------|-----------------|-------|----------------------|
| Days. | Hours. | Millimet. | Therm. cent. | Hygr. | State of the sky. | Days. | Hours. | Millimet. | Therm. cent. | Hygr. | State of the sky. |
| 24 | 3 | 762.06 | 24.8 | 83 | fine weather. | 25 | 5 | 761.70 | 26.5 | 98 | |
| - | 6 | 762.80 | 24.5 | 84 | (morning.) | + | 11 | 762.65 | 25.3 | 94 | |
| | 7 | 763.0 | 24.6 | 84 | | 26 | 7 | 762.35 | 24.5 | 94 | fine weather. |
| | 8 | 763.70 | 25.3 | 84 | | | 9 | 763.30 | 26.0 | 92 | (morning). |
| | 9 | 764.20 | 26.7 | 83 | | + | 10 | 763.45 | 27.4 | 94 | |
| + | 10 | 764.35 | 26.8 | 81 | | | 11 | 763.10 | 28.4 | 93 | |
| | 11 | 764.0 | 28.2 | | | | noon | 762.45 | 28.3 | 93 | |
| | 2 | 762.35 | 28.4 | | (evening.) | | 1 | 761.65 | 28.3 | 92 | (evening). |
| | 4 | 762.0 | 27.6 | 100 | rain. | | 2 | 761.65 | 28.1 | 93 | obs. weather. |
| 25 | 7 | 763.70 | 25.0 | 96 | fine weather. | | 3 | 760.65 | 28.0 | 93 | obs. weather. |
| | 8 | 763.95 | 26.2 | 95 | (morning). | - | 4 | 760.60 | 27.7 | 93 | clouded. |
| | 9 | 764.25 | 26.3 | 96 | | | 6 | 760.60 | 27.5 | 94 | very clouded. |
| + | 10 | 764.30 | 27.7 | 96 | | | 7 | 761.0 | 26.9 | 94 | (evening). |
| | 11 | 763.25 | 27.6 | 100 | fine weather. | | 8 | 761.20 | 26.8 | 93 | cloudy. |
| | noon | 762.95 | 26.9 | 100 | | + | 11 | 762.05 | 26.3 | 91 | cloudy. |
| | 2 | 761.70 | 27.0 | 100 | (evening). | | midnt. | 761.15 | 26.6 | 91 | |
| | 3 | 761.50 | 27.0 | | | 27 | 7 | 762.35 | 26.5 | 90 | (morning). |
| - | 4 | 761.50 | 27.0 | | | | 8 | 763.0 | 26.6 | 91 | |

HORARY VARIATIONS AT LA GUAYRA, HEIGHT 5 TOISES. (*Continuation.*)

NOVEMBER 1822.

| Days. | Hours. | Millimet. | Therm. cent. | Hygr. | State of the sky. |
|-------|--------------------------------|-----------|--------------|-------|-------------------|
| 27 | 9 | 763.25 | 27.3 | 89 | fine. |
| + | 10 | 763.45 | 28.6 | 89 | |
| | 11 | 763.15 | 18.7 | 89 | |
| | 2 | 760.25 | 29.2 | 86 | (evening). |
| - | 4 | 761.0 | 28.1 | 92 | storm. |
| | 8 | 761.15 | 27.0 | 90 | cloudy. |
| + | 11 | 762.60 | 26.2 | 89 | |
| 28 | 2 | 761.45 | 26.5 | 88 | (morning). |
| - | 3 | 761.10 | 26.5 | 90 | |
| | 6 | 762.0 | 27.0 | 99 | |
| + | 9 | 764.70 | 28.3 | 89 | |
| | 10 | 763.50 | 29.0 | 88 | |
| | 11 | 763.10 | 29.0 | 91 | obscure. |
| | 1 | 761.15 | 28.0 | 100 | (evening). |
| | 2 | 762.0 | 27.7 | 100 | storm. |
| - | 4 | 761.65 | 26.7 | 98 | |
| | 10 | 763.05 | 25.5 | 87 | |
| + | 11 | 763.20 | 26.0 | 95 | |
| 29 | 4 | 762.0 | 25.0 | 94 | (morning). |
| - | 7 | 763.75 | 26.0 | 100 | gale at sea. |
| | 8 | 764.0 | 26.5 | 100 | |
| + | 9 | 764.25 | 26.8 | 100 | fine weather. |
| - | 4 | 761.65 | 27.4 | 100 | |
| | 10 | 764.80 | 27.1 | 100 | |
| + | 10 ¹ / ₂ | 763.65 | 27.8 | 100 | |
| | midn. | 763.70 | 26.9 | 92 | |
| 30 | 8 | 764.0 | 26.0 | 90 | (morning). |
| - | 10 | 764.20 | 27.5 | 90 | |
| + | 11 | 763.95 | 28.7 | 93 | fine. |
| - | 4 | 761.80 | 27.9 | 92 | |
| + | 11 | 763.30 | 26.0 | 95 | (evening). |

DECEMBER 1822.

| Days. | Hours. | Millimet. | Therm. cent. | Hygr. | State of the sky. |
|-------|-------------------------------|-----------|--------------|-------|-------------------|
| 1 | 6 | 762.20 | 24.5 | 89 | |
| | 9 | 763.50 | 27.0 | 86 | |
| + | 10 | 763.90 | 27.9 | 90 | starry. |
| | 11 | 763.15 | 28.2 | 95 | |
| - | 4 | 761.35 | 27.8 | 86 | |
| + | 11 | 763.0 | 26.0 | 87 | |
| 6 | 10 | 762.65 | 27.0 | | (morning). |
| + | 11 | 762.0 | 27.2 | | blue. |
| | noon | 761.70 | 28.0 | | |
| | 1 | 761.35 | 28.5 | | (evening). |
| | 2 | 760.80 | 28.5 | | |
| | 4 | 760.70 | 27.7 | | |
| - | 4 ¹ / ₂ | 760.65 | 27.5 | | blue. |
| | 5 ¹ / ₂ | 761.0 | 26.5 | | |
| | 10 | 762.50 | 26.3 | | |
| 7 | 8 | 763.35 | 25.5 | | (morning). |
| | 9 ¹ / ₂ | 763.95 | 27.0 | | |
| + | 10 | 764.20 | 27.3 | | fine. |
| | 11 | 763.65 | 27.7 | | |
| | noon | 763.60 | 27.2 | | |
| - | 4 | 761.50 | 26.2 | | (evening). |

I have cited above, (Vol. iii, p. 326) some hor. observations made at La Guayra. On the 5th March, 1822, Colonel Lanzy found, at the house of the Commandant, with a barometer of Fortin 764,40, at ten in the morning, and at 4 in the evening, 761,50 : the th. marked 24° and 27° cent. M. Lanz (26 Feb.) observed on the sea-shore at noon, 767,05, the therm. being 26°.

HORARY VARIATIONS AT LIMA, SOUTH LAT. $12^{\circ} 2' 34''$;
 HEIGHT 85 TOISES. (*Observ. of M. de Humboldt*).

| NOVEMBER, 1802. | | | | NOVEMBER, 1802. | | | |
|-----------------|-----------------|---------|---------|-----------------|-----------------|----------|-----------------|
| Days. | Hours. | Baromet | Th. Fa. | Days. | Hours. | Baromet. | Th. Fa. |
| 19 | 15 | 329.90 | 63.3 | 22 | $1\frac{1}{2}$ | 329.32 | $78\frac{1}{2}$ |
| — | 16 | 330.40 | | — | $5\frac{1}{2}$ | 329.49 | 68 |
| | 21 | 330.69 | | | $6\frac{1}{2}$ | 329.73 | 66 |
| + | $22\frac{3}{4}$ | 330.54 | 65.2 | | $7\frac{1}{2}$ | 329.78 | 65 |
| 20 | 0 | 330.13 | | | 8 | 329.86 | 67.8 |
| | 1 | 330.60 | | | 9 | 330.27 | 65.5 |
| | 2 | 329.92 | 68.5 | + | 11 | 330.25 | 65.5 |
| | 3 | 329.80 | | | $12\frac{1}{2}$ | 330.13 | 65 |
| | $3\frac{1}{2}$ | 329.78 | | + | 21 | 330.87 | 68.5 |
| — | 4 | 329.73 | | | $21\frac{1}{2}$ | 330.83 | 71 |
| | 5 | 330.00 | | | $22\frac{3}{4}$ | 330.27 | 76.5 |
| | 7 | 330.13 | 66 | | 0 | 330.00 | |
| | 8 | 330.54 | 65 | 23 | 1 | 329.86 | 80.5 |
| | $9\frac{1}{4}$ | 330.54 | | | $2\frac{3}{4}$ | 329.59 | $79\frac{1}{4}$ |
| | 10 | 330.76 | 64.5 | | $3\frac{1}{2}$ | 329.46 | 76 |
| + | 11 | 330.69 | | — | 44 | 329.59 | 73 |
| | $11\frac{1}{2}$ | 330.27 | 65.5 | | $5\frac{1}{4}$ | 329.73 | 71.2 |
| 20 | 18 | 330.26 | | | $7\frac{1}{4}$ | 330.54 | 68 |
| + | $20\frac{3}{4}$ | 330.54 | 70.3 | | 8 | 330.67 | 65 |
| | $23\frac{1}{2}$ | 329.89 | 80.5 | | $9\frac{3}{4}$ | 330.81 | 64.5 |
| 21 | 1 | 329.59 | 79 | + | 11 | 330.94 | 65 |
| | $2\frac{1}{2}$ | 329.32 | 75 | | 1 | 330.54 | 65 |
| | 3 | 329.05 | 74 | | | | |
| — | 4 | 328.92 | 72 | | | | |
| | $7\frac{1}{2}$ | 328.86 | 64.5 | | | | |
| | 8 | 330.00 | 65 | | | | |
| | 9 | 330.06 | | | | | |
| | $9\frac{1}{2}$ | 330.13 | | | | | |
| | 10 | 330.13 | 65.6 | | | | |
| + | 11 | 330.13 | | | | | |
| | 12 | 330.13 | 65 | | | | |
| | $20\frac{3}{4}$ | 330.59 | 70 | | | | |
| | $22\frac{1}{2}$ | 330.40 | 74 | | | | |
| | 0 | 330.13 | 80 | | | | |
| + | $0\frac{1}{4}$ | 329.86 | 79 | | | | |
| 22 | 1 | 329.46 | 79 | | | | |

The 20th, by obscure and foggy weather; the 21st by a clear sky.

The weather was foggy at Callao de Lima till five in the morning, on the 9th November. The barometrical observations were made with an excellent English barometer of Gabory, belonging to M. de Quevedo, captain of a ship, commanding the Spanish frigate *la Rufina*. (The hundredths of English inches were reduced into fractions of lines of the ancient French foot). I have here previously noted some Peruvian observations, in order to present in the same point of view, the horary variations between the tropics, and on the north and south of the equator.

HORARY VARIATIONS AT THE PORT OF CALLAO, SOUTH LAT.
 12° 3' 19"; HEIGHT 6 TOISES. (*Observ. of M. de Humboldt.*)

| NOVEMBER, 1802. | | | | NOVEMBER, 1802. | | | |
|-----------------|--------|----------|-----------|-----------------|--------|----------|-----------|
| Days. | Hours. | Baromet. | Th. cent. | Days. | Hours. | Baromet. | Th. cent. |
| 8 Nov. | 20 | 337.05 | | + | 21 | 337.35 | 18.3 |
| + | 21 | 337.28 | | | 22½ | 337.13 | 20.4 |
| | 22 | 337.23 | 19.2 | 9 Nov. | 0½ | 336.90 | 20.1 |
| | 2½ | 336.85 | | | 0¾ | 336.75 | |
| | 3 | 336.68 | 20.4 | | 3½ | 336.63 | 22.8 |
| | 3¾ | 336.65 | | | 4 | 336.45 | |
| | 4 | 336.50 | | | 5 | 336.50 | 18.4 |
| - | 5¼ | 336.75 | | | 8 | 336.85 | |
| | 7 | 337.10 | 17.3 | | 9 | 336.95 | 16.5 |
| | 7¾ | 337.20 | | | 10 | 386.97 | |
| | 8¾ | 337.25 | | + | 11 | 336.15 | |
| | 9 | 337.25 | | | 11½ | 336.90 | 16.7 |
| | 10 | 337.30 | 16.3 | | 13 | 336.84 | |
| | 11 | 336.98 | | | 20 | 337.55 | |
| + | 13 | 336.72 | | | 20½ | 337.65 | 17.3 |
| | 14 | 336.60 | | + | 21 | 337.57 | |
| | 15 | 336.65 | | | 22 | 337.45 | |
| | 15½ | 336.62 | 16.0 | 10 | 23½ | 337.30 | 19.2 |
| | 16 | 336.55 | | | 0 | 337.25 | |
| - | 16½ | 336.80 | | | 0½ | 337.05 | |
| | 17 | 336.87 | 16.4 | | 1 | 336.90 | |
| | 17½ | 336.95 | | | 1½ | 336.93 | 21.5 |
| | 20 | 337.25 | 18.0 | | ½ | 336.60 | |

HORARY VARIATIONS OBSERVED ON THE COAST OF AFRICA,
AND AT TAITI.

AT SIERRA LEONE (LAT. 8° 30' NOR.) BY CAPTAIN SABINE.

| | Bar. | Therm. | | Bar. | Therm. |
|------------------|--------|----------|------------------|--------|--------|
| Mar. 20, at 21h. | 29.875 | 81.2° F. | Mar. 21 at + 10h | 29.870 | |
| + 21½ | 29.876 | | 19 | 29.818 | 80.7° |
| 22 | 29.872 | | 22 | 29.828 | |
| Mar. 21 | 0 | 29.876 | + 22½ | 29.830 | |
| 0½ | 29.872 | | 23 | 29.828 | |
| 2 | 29.828 | 84° | Mar. 22 | 3 | 29.774 |
| 3¼ | 29.810 | | — 4 | 29.760 | |
| — 4 | 29.808 | 81° | 5 | 29.772 | |
| 8½ | 29.812 | | 9 | 29.808 | |
| 9 | 29.850 | 80° | + 10 | 29.814 | 82.5° |

HORARY VARIATIONS OBSERVED AT TAITI.

AT TAITI (LAT. 17° 29' SOUTH), BY M. IWAN SIMONOFF.

| | Bar. | Therm. | | Bar. | Therm. |
|-----------------|-------|---------|-----------------|-------|--------|
| Aug. 5, at 14h. | 30.06 | 80½° F. | Aug. 6 at — 16h | 30.11 | 79° |
| — 15 | 30.05 | | 20 | 30.18 | 77° |
| 17 | 30.08 | 79° | + 21 | 30.19 | |
| + 20 | 30.14 | | 0 | 30.17 | 79° |
| 21 | 30.13 | 78½° | — 3 | 30.11 | |
| Aug. 6, | 0 | 30.07 | 7 | 30.16 | 79° |
| — 4 | 30.05 | 80° | + 10 | 30.18 | |
| 9 | 30.14 | 78° | 14 | 30.14 | |
| + 10 | 30.15 | | — 15 | 30.13 | 79° |
| 15 | 30.12 | | | | |

HORARY VARIATIONS AT CHITTEDROOG, ON THE TABLE-
LAND OF MYSORE (NORTH LAT. $14^{\circ} 11'$), AT THE ELEVATION OF 400 TOISES, OBSERVED BY CAPTAIN KATER.

| Days. | Hours. | Baromet. | Therm. | Days. | Hours. | Baromet. | Therm. |
|--------|--------|----------|--------|---|--------|----------|--------|
| Aug. 5 | 0 | 27.51 | 75 F. | Aug. 6 | 13 | 27.45 | 70 F. |
| | 2 | 27.48 | 74 | | 15 | 27.43 | 70 |
| | 3 | 27.48 | 73 | — | 17 | 27.42 | 71 |
| — | 5 | 27.46 | 72 | | 18 | 27.43 | 71 |
| | 6 | 27.47 | 72 | | 20 | 27.46 | 71 |
| + | 8 | 27.51 | 72 | + | 23 | 27.50 | 73 |
| | 9 | 27.51 | 73 | Aug. 7 | 1 | 27.50 | 74 |
| | 12 | 27.51 | 71 | | 3 | 27.45 | 76 |
| — | 15 | 27.44 | 71 | — | 4 | 27.44 | 75 |
| | 17 | 27.44 | 71 | | 5 | 27.47 | 75 |
| | 19 | 27.44 | 72 | | 8 | 27.50 | 73 |
| | 20 | 27.48 | 72 | + | 11 | 27.51 | 72 |
| + | 22 | 27.48 | 74 | | 13 | 27.51 | 72 |
| | 23 | 27.49 | 75 | | | | |
| Aug. 6 | 1 | 27.47 | 76 | <p>The barometric heights, in hundredths and thousandths of the English inch, in the observations of Africa, Taiti, and Asia. The latter were made during rainy weather, and at the season of monsoons.</p> | | | |
| | 2 | 27.45 | 76 | | | | |
| — | 3 | 27.42 | 76 | | | | |
| | 4 | 27.42 | 76 | | | | |
| | 5 | 27.42 | 75 | | | | |
| | 6 | 27.45 | 73 | | | | |
| + | 10 | 27.50 | 72 | | | | |
| | 12 | 27.50 | 70 | | | | |

HORARY VARIATIONS AT CARACCAS, NORTH LAT. $10^{\circ} 30' 50''$;
HEIGHT 480 TOISES. (*Observ. of M. de Humboldt.*)

NOVEMBER AND DECEMBER, 1799.

| Days. | Hours. | Baromet. | Therm. of R. | Days. | Hours. | Baromet. | Therm. of R. |
|---------|------------------|----------|-----------------|--------|------------------|----------|-----------------|
| Nov. 30 | 19 $\frac{1}{2}$ | 303.70 | 13 $^{\circ}$ | Dec. 3 | 20 $\frac{1}{2}$ | 304.22 | |
| + | 21 | 304.21 | 15 $^{\circ}$ | + | 21 | 304.40 | 15.0 $^{\circ}$ |
| | 22 | 304.05 | | | 22 | 304.25 | |
| | 23 | 304.00 | | | 22 $\frac{1}{2}$ | 304.20 | |
| Dec. 1 | 0 | 303.82 | | | 23 | 304.15 | |
| | 0 $\frac{1}{2}$ | 303.60 | | 5 | 0 | 303.80 | |
| | 1 | 303.52 | 18.7 $^{\circ}$ | | 1 | 303.72 | |
| - | 4 | 303.00 | | - | 4 | 303.00 | 18.0 $^{\circ}$ |
| | 5 | 303.25 | | | 5 | 303.20 | |
| + | 11 | 303.84 | | + | 11 | 303.75 | 13.0 $^{\circ}$ |
| | 12 | 303.60 | | | 19 $\frac{1}{2}$ | 304.00 | |
| | 20 | 303.92 | | | 20 | 304.10 | |
| | 21 | 304.03 | 16.4 $^{\circ}$ | | 20 $\frac{1}{2}$ | 304.20 | |
| | 23 | 303.80 | | + | 21 | 304.32 | |
| Dec. 2 | 0 | 303.77 | 18.2 $^{\circ}$ | | 21 $\frac{1}{2}$ | 304.32 | |
| - | 4 | 303.00 | | | 23 | 304.02 | 17.0 $^{\circ}$ |
| | 5 $\frac{1}{2}$ | 303.02 | | 6 | 0 | 303.85 | |
| | 11 | 303.70 | | | 5 | 303.46 | |
| | 13 | 303.92 | | - | 4 | 303.30 | |
| | 20 | 303.60 | 14.9 $^{\circ}$ | | 3 | 303.22 | |
| | 20 $\frac{1}{2}$ | 303.82 | | | 6 $\frac{1}{2}$ | 303.40 | 15.0 $^{\circ}$ |
| + | 21 | 304.00 | | + | 11 | 303.72 | |
| | 21 $\frac{1}{2}$ | 303.92 | | | 12 | 303.60 | |
| | 23 | 303.80 | | + | 21 | 304.20 | |
| Dec. 3 | 0 | 303.72 | 17.5 $^{\circ}$ | | 23 | 303.92 | |
| | 0 $\frac{1}{2}$ | 303.55 | | 7 | 0 $\frac{1}{2}$ | 303.70 | |
| | 1 $\frac{1}{2}$ | 303.40 | 18.2 $^{\circ}$ | | 3 $\frac{1}{2}$ | 303.10 | 18.2 $^{\circ}$ |
| - | 4 | 303.10 | | | 4 | 303.00 | |
| | 7 | 303.62 | | | 7 | 303.32 | 16.0 $^{\circ}$ |
| | 10 | 303.85 | | | 10 $\frac{1}{2}$ | 304.01 | |
| + | 11 | 303.90 | | + | 11 | 304.05 | 13.7 $^{\circ}$ |
| | 12 | 303.82 | | | 11 $\frac{1}{2}$ | 303.95 | |
| | 14 | 303.63 | | | 18 | 303.80 | |
| | 20 $\frac{1}{2}$ | 304.25 | 14.9 $^{\circ}$ | | 20 | 304.25 | |
| + | 21 | 304.40 | | + | 21 | 304.40 | |
| | 22 | 304.32 | | 8 | 0 | 304.15 | |
| | 22 $\frac{1}{2}$ | 304.30 | | - | 4 | 303.00 | |
| | 3 | 303.20 | | | 5 | 303.25 | 16.2 $^{\circ}$ |
| 4 | 4 | 303.12 | 18.2 $^{\circ}$ | | 7 $\frac{1}{2}$ | 303.40 | |
| - | 7 | 303.64 | | | 11 | 304.00 | 14.0 $^{\circ}$ |
| + | 11 | 303.92 | | | 16 | 303.68 | |
| | 12 | 380.80 | | | 17 | 303.76 | |

HORARY VARIATIONS AT CARACCAS, HEIGHT 480 TOISES.
(Continuation.)

DECEMBER, 1799.

| Days. | Hours. | Baromet. | Therm. of R. | Days. | Hours. | Baromet. | Therm. of R. | |
|---------|--------|----------|-----------------|---|--------|----------|-----------------|--|
| Dec. 20 | 20 | 303.62 | 45.5° | — | 4 | 302.54 | 17.8° | |
| + | 21 | 303.80 | | + | 11 | 303.10 | | |
| | 23 | 303.65 | | + | 21 | 303.55 | | |
| 21 | 0 | 303.60 | | 24 | 0 | 303.20 | | |
| — | 4 | 302.75 | 14.3° | — | 4 | 302.75 | 13.4° | |
| | 10 | 303.30 | | + | 11 | 303.80 | | |
| + | 11 | 303.45 | | <p>From the 30th of November, till the 8th of December, a serene sky; but from the 20th to the 24th of December, impetuous rains and winds.</p> | | | | |
| + | 21 | 303.70 | | | | | | |
| 22 | 0 | 303.52 | | | | | | |
| — | 4 | 302.54 | | | | | | |
| + | 11 | 303.10 | | | | | | |
| + | 21 | 304.00 | | | | | | |
| 23 | 0 | 302.95 | | | | | | |

HORARY VARIATIONS AT IBAGUE, NORTH LAT. 4° 27' 45";
HEIGHT 703 TOISES. (*Observ. of M. de Humboldt*).

| SEPTEMBER, 1801. | | | | SEPTEMBER, 1801. | | | |
|--|----------------|------------|------------|------------------|-----------------|-------|-----------|
| 23 at | 0 ^h | Bar. 292.6 | Th. 18° R. | 24 at | 20 ^h | 293.0 | Th. 19.3° |
| | 1½ | 292.5 | | + | 21 | 293.7 | Th. 20.2° |
| — | 4 | 292.3 | Th. 19° | 25 at | 0 | 293.6 | |
| | 7½ | 292.7 | | — | 4 | 292.8 | Th. 20.0° |
| | 9½ | 293.0 | | | 7 | 293.1 | Th. 18.2° |
| + | 11 | 293.1 | | | 9 | 293.4 | |
| | 12 | 293.1 | Th. 17.6° | + | 11 | 293.5 | Th. 17.7° |
| + | 21½ | 293.4 | | | 18½ | 294.0 | |
| 24 at | 0½ | 293.3 | | + | 21½ | 294.6 | |
| | 2½ | 292.7 | Th. 19° | 26 at | 2½ | 293.7 | Th. 21.3° |
| — | 4 | 292.5 | | — | 4½ | 293.5 | Th. 18.2° |
| | 7 | 292.8 | | | 10 | 294.3 | |
| | 9½ | 293.2 | Th. 16° | + | 11 | 294.5 | |
| + | 11 | 293.3 | | | 12 | 294.2 | |
| | 12 | 293.2 | | + | 20½ | 294.7 | Th. 21° |
| The small town of Ibague is situated in a high valley at the foot of the Andes of Quindiu. | | | | 27 at | 1 | 294.1 | |
| | | | | — | 4 | 294.0 | |

HORARY VARIATIONS AT POPAYAN, NOR. LAT. $2^{\circ} 26' 17''$;
 HEIGHT 911 TOISES. (*Observations made in May, 1801, by
 Don Josef Caldas.*)

| MAY, 1801. | | | MAY, 1801. | | |
|----------------------|-------|-----------------------|---|-------|---------------------|
| 16 at 3 ^h | 274.8 | Th. 16 ^o | 19 | 275.3 | |
| — 4 | 274.7 | | 21 | 275.4 | |
| 7 | 274.9 | | 19 at 2 | 275.3 | |
| 9 | 275.5 | | 3 | 275.2 | |
| + 11 | 275.6 | | + 10 | 275.4 | |
| 19 | 275.1 | | 20 at 20 | 275.3 | Th. 14 ^o |
| 21 | 275.3 | Th. 15 ^o | + 22 | 275.4 | |
| 22 | 275.1 | | 21 at 0 | 275.1 | |
| 17 at 3 | 274.4 | | — 3 | 274.5 | |
| — 4 | 274.3 | | 7 | 275.0 | |
| 7 | 274.4 | | + 11 | 275.3 | |
| 8 | 274.7 | | 18 | 275.3 | |
| + 9 $\frac{1}{2}$ | 274.9 | | + 21 | 275.3 | |
| 10 | 274.9 | Th. 15 ^o | 23 | 275.0 | |
| 19 | 274.9 | Th. 14.5 ^o | 22 at 2 | 274.4 | |
| + 21 | 275.1 | | — 3 | 274.3 | |
| 18 at 0 | 274.9 | | + 10 | 275.1 | |
| — 2 | 274.3 | | The thermometer of the division of Reaumur; the bar. heights, as at Cu- mana, Lima, Callao, Caraccas, and Ibague, in tenths and hundredths of lines of the French foot. | | |
| 3 | 274.3 | | | | |
| 6 | 274.5 | | | | |
| 7 | 274.9 | | | | |
| 8 | 275.0 | | | | |
| + 9 | 275.3 | Th. 14 ^o | | | |

HORARY VARIATIONS OBSERVED AT MEXICO, AND AT QUITO,
BY M. DE HUMBOLDT.

AT MEXICO, NOR. LAT. $19^{\circ} 25' 45''$; HEIGHT 1168 TOISES, IN JUNE 1803.

| | | | | | |
|-----------------------|--------|------------------------|-----------------------|--------|-----------------------|
| 26 at 8 ^h | 259.70 | Th. 63 ^o F. | 27 at 11 ^h | 259.78 | |
| + 11 | 259.87 | | + 12 | 259.70 | Th. 62 ^o |
| 13 | 259.75 | Th. 61 ^o | 13 | 259.45 | Th. 61 ^o |
| - 16 | 259.40 | | - 16 | 259.21 | Th. 59 ^o |
| 18 $\frac{1}{4}$ | 259.75 | Th. 58.5 ^o | + 20 $\frac{1}{2}$ | 259.65 | Th. 63 ^o |
| + 21 | 259.90 | Th. 65 ^o | 21 $\frac{1}{4}$ | 259.65 | |
| 21 $\frac{1}{4}$ | 259.85 | Th. 66 ^o | 21 $\frac{3}{4}$ | 259.55 | Th. 67 ^o |
| 22 | 259.68 | | 2 | 258.58 | Th. 73.5 ^o |
| 22 $\frac{1}{2}$ | 259.69 | Th. 68 ^o | - 3 $\frac{3}{4}$ 3 | 258.70 | Th. 71 ^o |
| 23 | 259.55 | Th. 68.5 ^o | 4 | 258.70 | |
| 27 at 0 $\frac{1}{2}$ | 259.70 | Th. 71 ^o | 4 $\frac{1}{2}$ | 258.75 | Th. 70 ^o |
| - 4 | 258.90 | Th. 70 ^o | + 11 | 259.26 | Th. 67 ^o |
| 7 $\frac{1}{2}$ | 259.47 | Th. 64 ^o | 12 | 259.00 | Th. 64 ^o |

AT QUITO, SOUTH LAT. $0^{\circ} 14'$; HEIGHT 1492 TOISES, IN APRIL 1802.

| | | | | | |
|----------------------|--------|------------------------|------------------------|--------|-----------------------|
| 4 at 20 ^h | 244.00 | Th. 57 ^o F. | 6 at 4 $\frac{3}{4}$ h | 244.61 | Th. 56 ^o |
| 21 | 244.32 | Th. 60 ^o | 6 | 244.25 | Th. 54 ^o |
| 23 | 244.25 | Th. 63 ^o | 7 $\frac{1}{4}$ | 244.15 | |
| 5 at 2 | 244.15 | Th. 65 ^o | 10 | 244.10 | Th. 47 ^o |
| 3 | 244.15 | Th. 59 ^o | 19 | 243.70 | Th. 45 ^o |
| 7 | 243.60 | Th. 55 ^o | 20 $\frac{3}{4}$ | 244.45 | Th. 63 ^o |
| 8 $\frac{1}{2}$ | 243.75 | Th. 54 ^o | 22 | 244.65 | Th. 66 ^o |
| 10 $\frac{1}{4}$ | 243.80 | Th. 52 ^o | 22 $\frac{3}{4}$ | 244.70 | Th. 67 ^o |
| 12 | 243.61 | Th. 51 ^o .5 | 7 at 2 $\frac{1}{2}$ | 244.70 | |
| 20 $\frac{1}{2}$ | 244.22 | Th. 58 ^o | 4 | 244.65 | Th. 66.5 ^o |
| 22 | 244.70 | Th. 67 ^o | 7 | 244.65 | Th. 58 ^o |
| 6 at 0 $\frac{1}{2}$ | 244.70 | | 11 $\frac{1}{4}$ | 244.15 | Th. 52 ^o |
| 3 $\frac{1}{4}$ | 244.70 | Th. 61 ^o | 12 $\frac{1}{2}$ | 243.90 | Th. 53 ^o |

HORARY VARIATIONS AT THE TABLE-
LAND OF ANTISANA, SOUTH LAT.
 $0^{\circ} 32' 52''$; HEIGHT, 2104 TOISES.
(*Observations of M. de Humboldt*).

| | | |
|---------------------------|--------|-----------------------|
| Mar. 16 at 4 ^h | 208.60 | Th. 8 ^o R. |
| 8 | 208.78 | Th. 7.2 ^o |
| 13 | 208.20 | Th. 6 ^o |
| 18 | 208.50 | Th. 5.4 ^o |

The horary variations of Quito and Antisana were observed in rainy weather. They are at that period less sensible, and less regular than at Mexico, and Santa Fe de Bogota.

In order to avoid in the preceding tables the frequent repetition of the words *morning* and *evening*, the hours are counted (according to the ancient method of astronomers,) from the passage of the sun over the meridian, so that the 21st hour corresponds to nine in the morning. The barometric heights are indicated either in millimetres (in the observations of MM. Boussingault and Rivero), or in lines, and hundredths of lines of the French foot (in my observations at Cumana, la Guayra, Callao, Lima, Caraccas, Ibague, Popayan, Mexico, Quito, and Antisana); or finally, in inches, and hundredths of the English inch, (in the observations of MM. Kater, Sabine, and Simonoff). The thermometer was suspended by the side of the barometer, when it was not placed in the instrument itself. The barometric heights are not yet corrected by the temperature, that is, they have not been reduced to zero, or to the same degree above the freezing point. It thence results that, as the barometer sinks from 21 hours to 4, while the heat augments, the extent of the diurnal variation is partly masked in the tables, by this increase of temperature; the same thing takes place from 4 till 11; the movement of the thermometer being still opposed to that of the barometer. On the contrary, the apparent extent of the variations in the atmospheric tides, from 11^h to 16^h, and

from 16^h to 21^h, are greater than the real variations, because at those epochas the barometer and thermometer rise and sink together.

The same thing has happened in respect to the horary variations of the barometer, as takes place with respect to a great number of important phenomena, which the history of physical discoveries displays in the first instance, that are either vaguely perceived, or carefully examined, but published by insulated observers, who enjoy little celebrity. These phenomena remain forgotten if the learned, or the academies, which in every age exert a great influence on the progress of the sciences, have not made them an object of their researches. When, afterwards, by the union of several observers known by other labours, or by a more complete discussion of the phenomena, doubts are dissipated, things are then eagerly recognized as anciently known, which it is no longer permitted to neglect as ill-observed. A learned man, father Cotte, who has rendered essential services to meteorology, attributed, in 1774, notwithstanding the uniform testimony of so many travellers who had visited the tropics, the regularity of the horary variations to the imperfection of the barometers, that is, to a small quantity of air contained in the void of Torricelli, and susceptible of being dilated and condensed by the increasing and de-

creasing heat of the day *. The first horary observations having been made only near the coast, Mr. Playfair, whose extensive knowledge and superior abilities have never been contested, believed for a long time † that the atmospheric tides observed in the equinoxial zone, were owing to the alternating winds from land and sea. The periodical regularity of those tides may now be regarded as one of the physical phenomena that are best known and most universally verified. It has been ascertained at the same time in the vast extent of the Ocean, and in the interior of the land; in plains, and at two thousand toises of height; between the tropics, and in the temperate zones of the two hemispheres. Before I mention the results that may be drawn from the numerous observations comprised in the preceding tables, I shall relate succinctly and in chronological order, the various attempts of naturalists to verify the regularity of the horary variations of the barometer.

* *Cotte, Traité de Météorologie, 1774, p. 314.* The author did not recollect that the *minima* of the pressure correspond at the same time with the hottest and coldest hours of night and day.

† *Edinb. Trans., Vol. v, pl. iii, p. 6.* The same cause was indicated later by captain Flinders, whose long and mysterious detention was deplored by all the friends of justice, humanity, and the sciences. (*Tuckey, Marit. Geogr., Vol. i, p. 525.*)

MM. Varin, de Hayes, and de Glos* remarked, in 1682, in a voyage undertaken by the King's order, to Cape Verd and the American islands, "that the barometer at Gøree is generally lowest when the thermometer is highest, and usually two to four lines higher at night than in the day; and that this instrument changes more from morning till night, than from night till morning."

The observations of father Beze, on the ascension of the barometer in the coolest hours of the day, are also no less vague and inexact†. He has been erroneously cited‡ by some naturalists, as having discovered at Pondicherry and Batavia, in 1690, the regularity of the horary variations in the tropics. Father Beze observes only, "that he is of the opinion of one of his friends, who thinks that the height of the barometer being so constant in the equinoxial regions, may serve as a common measure, sure, and easily found, for all the different nations of the earth." It appears singular that Richer, charged by the academy in 1671, to examine if the (mean) barometric height was the same at Cayenne and at Paris, had not fixed his attention on the horary variations §.

* *Mém. de l'Acad.*, Vol. vii, p. 452.

† The barometer and thermometer mount at the same time, from sunrise to nine in the morning.

‡ *L. c.* p. 839.

§ *L. c.* p. 323.

The phenomenon of horary variations was observed in 1722, for the first time, and pretty completely in the tides of day and night, by a Dutch naturalist, whose name has not descended to our times. It is said, in the *Literary Journal of the Hague*: "The mercury rises * in that part of Dutch Guyana, every day regularly from 9^h in the morning to nearly 11^½^h; after which it descends till towards 2^h or 3^h in the afternoon, and then returns to its first height. It has nearly the same variations at the same hours of the night; the variation is about $\frac{1}{2}$ of a line or $\frac{3}{4}$ of a line, at the utmost a whole line. It were to be wished that the philosophers of Europe would make their conjectures on this point." The observations I made seventy-seven

* See extract of a letter from Surinam, in the *series of the year 1722*, p. 234. The observations in that letter prove that the author was occupied in determining the *mean height* of the barometer at the Hague and at Surinam. After observations of six years, he believes the former to be 336·1 lines, and the latter 336·5 lines (without correction of the temperature?). He also states a very remarkable regularity in the hours when the rains begin in Dutch Guyana. "In the humid season," says he, "the rains at first begin between nine and ten in the morning, and continue every day till between three and four in the afternoon; they afterwards begin towards eleven or twelve; then, towards one or two; and, finally, towards three or four in the afternoon, after which they cease entirely. It very seldom rains in the night; the air, at break of day, is serene at all seasons."

years later, near this coast of Surinam, on the banks of the Oroonoko, confirmed, with the exception of the hour of the *maximum* of the morning, the precision of the first view of the periods; they prove also that the Dutch traveller had watched several nights to determine the *minimum* which precedes two or three hours the rising of the sun. With respect to the “conjectures of the philosophers of Europe,” of which the correspondent of Surinam desires to be informed, we cannot hitherto offer any that are satisfactory.

Father Boudier*, from 1740 to 1750, had observed the barometer at Chandernagor in India. He remarked, in the manuscript journals preserved among the papers of M. de l'Isle, “that the greatest elevation of the mercury takes place every day towards nine or ten in the morning, and the least elevation towards three or four in the afternoon, and that during the great number of years that the barometer has been fixed at Chandernagor, there are not eight or ten days in which this uniform movement of mercury has not been observed.” Yet Chandernagor is situated nearly at the extremity of the equinoxial region, in $22^{\circ} 51'$ north latitude.

The academicians who were sent to Quito in

* See Cotte, *Traité de Meteorologie*, p. 243. B. *Memoires sur la Meteorologie*, Vol. ii, p. 302.

1735, had no knowledge when they left Europe, of the observations made at Surinam, on the regularity of the atmospheric tides; MM. Bouguer and Condamine attributed the discovery of this regularity to one of their colleagues, M. Godin. "I also made some observation, says la Condamine *, on the barometer, in the year 1741, at first with M. Godin, and afterwards alone, in order to confirm M. Godin's remark, who first perceived several daily and periodical variations. I found the barometer at its greatest height towards nine in the morning, and at its least towards three in the afternoon; the mean difference (at Quito) was $1\frac{1}{4}$ of a line." M. de la Condamine, in his *Relation du Voyage à l'Amazone*, returns to the same subject. "M. Godin," he says, "remarked that the variations of the barometer (in the equinoxial zone,) alternate very regularly; one experiment consequently suffices to judge of the mean barometric height †."

* *Voyage to the Equator*, p. 50 and 109. Bouguer, who speaks with the same brevity of the observation of Godin, adds, that the variations of the barometer at the equator, are two to three lines at the seashore, and about one line at Quito. (*Figure de la Terre*, p. 39). We see by the work of M. Thibault de Chanvalon, that Bouguer's manuscripts contained a great number of unpublished horary observations. *Voyage à la Martinique*, p. 135 (22).

† *Voyage à la Riv. des Amaz.*, p. 23. I have founded on

In 1756, a naturalist, whose sagacity and rare merit were not sufficiently appreciated by his contemporaries, M. Thibault de Chanvalon*, first reduced the horary observations he had made in the West Indies, into tables. "The barometer," he observes, in a work which was not published before 1761, "is entirely useless at Martinique to indicate the variations of the weather; but it affords a singularity which merits to be studied in all its details, and which had been already perceived by an observer at Surinam; but either from the small confidence which travellers generally inspire, doubt was preferred to investigation, or because it requires some celebrity to give credit to extraordinary facts, the truth was never clearly presented to the public. The regularity of the horary variations may be said to have been unknown till the journey of M. Godin to Quito. Soon after my arrival at Martinique, I perceived that the barometer mounted insensibly the whole morning, and after having remained some time without movement, began to lower at sunset. The most considerable revolutions of the atmosphere do not alter this periodical movement of the barometer, which coincides

an analogous observation, the table I have given for the horary observations applied to the calculations of the height of places, in my collection of *Astron. Obs.*, Vol. i, p. 289.

* *Voyage to Martinique*, p. 135 (20, 21, 25).

sufficiently with the horary variations of the magnetic inclination. Amidst the most violent rains, winds, and storms, the mercury rises or sinks, if it be its time to mount or descend, as if the air were perfectly calm. The same variation takes place at Senegal; for Mr. Adamson, to whom I mentioned it on my arrival in France, had verified the fact by a long series of observations made by a friend in Africa, to whom he had sent a barometer."

Since the year 1761, Doctor Mutis, who cultivated every branch of physical science with success, observed the atmospheric tides at Santa Fe de Bogota, with the greatest assiduity, and during forty years. Above all, he fixed with precision the period of the *minimum* which precedes the sunrise *. Unfortunately, this great mass of observations, which their author concealed with too much care during his life, was only published after his death. M. Mutis, in New Grenada, and Alzate and Gama, in Mexico, are the first naturalists who examined the phenomenon of the horary variations on the back of the Cordilleras, at 1200 to 1400 toises above the level of the sea. Alzate speaks of the hours of the *maximum* and the *minimum*, in the

* *Papel per de Santa Fe de Bogota, para 7 Febr. 1794, p. 128*; and *Semanario de el Nuevo Reyno de Gran.*, Tom. i, p. 55, 128.

introduction of a memoir somewhat rare, and which bears the title of *Observaciones meteorologicas de los ultimos nueve meses de el año, 1769*. The horary observations made at Mexico were at first regarded by Cotte, as owing to the imperfection of the instruments ; but, from the year 1784, consequently long before he could have any knowledge of the labors of Lamanon, he recognized * his first error, in attributing the phenomenon “ which he thinks he observed in Europe, to a cause which has some relation to the atmospheric tides occasioned by the moon.”

Neither the observations of Thibault de Chanvalon (1751), nor the small number published by Alzate (1769) corresponded to the *tropical hours*, that is, to the epochas when the barometer arrives at the convex, or concave summits of the curve of its diurnal variations ; in the voyage of Le Perouse, MM. Lamanon and Monzes made the first continued observations in 1785, from hour to hour, during three days and three nights. They were then in the middle of the Atlantic Ocean, between the parallels of 1° nor. lat. and 1° south lat. †

The labors of Lamanon are eight years anterior to those which were undertaken at Calcutta

* *Memoirs of Meteorology*, Tom. ii, p. 304.

† *Voyage de la Perouse*, 1797, Tom. iv, p. 257, 264.

by MM. Trail, Farquhar, Pearce, and Balfour ; but as the results of the latter were inserted in the fourth volume of the *Asiatic Researches*, published at Calcutta in 1795, while the voyage of the unfortunate Prowse appeared only in 1797, the observations of India acquired more celebrity in Europe ; and from them, at my departure for America, I learnt the regularity of the horary movements of the barometer. Ideas too systematic on the *periodicity* of all the maladies in the torrid zone, and on the influence of the moon on the vital movements, had fixed the attention of some English physicians in the West Indies and at Calcutta, on the variations of the weight of the atmosphere. Doctor Moseley* speaks of horary changes, in his *Treatise on Tropical Diseases* (1792, p. 3, 550, and 556), and Doctor Balfour, who had not less faith in lunar and solar in-

* "The barometer," says Moseley, "presents a phenomenon, in the English West India Islands, and other regions of the tropics, which is not yet verified in the temperate zone ; the mercury has two movements by day ; one of descent, the other of ascension ; they correspond to the diurnal progress of the sun. The mercury mounts as the sun approaches the zenith and the nadir, and descends as the sun recedes from those points." This coincidence is not rigorously true. The author might have observed that the *maxima* precede the passage of the sun by the zenith and the nadir, from one to three hours, and that the *minima* succeed that passage an equal number of hours.

fluence on fevers than the physicians of Jamaica, had the patience to observe the barometer at Calcutta in 1794, during a whole lunar revolution, every half hour.

I began, with M. Bonpland, the series of my observations on the variations of the weight of the atmosphere, July 18th, 1799, two days after our arrival at Cumana, and continued them carefully during five years, from the 12° of south latitude to the 23° of north latitude, in plains, and on table-lands of the same height as the peak of Teneriffe. Since the period of my voyage to the equator, this phenomenon has occupied the attention of almost all the travellers and naturalists furnished with instruments fitted to make accurate observations. I shall confine myself to the mention of the observations of M. Horsburgh * during his stay on the coasts of China and India; of Captain Kater, in the high plains of Mysore; of M. Ramond, in Auvergne; of MM. Langsdorf and Horner †, who in Krusenstern's Voyage, united more than 1400 barometric heights; of M. d'Eschwege, in the missions of the Coroatos Indians, and on the table-land that surrounds the presidio of S.

* See the letter of this learned navigator, to Henry Cavendish, in the *Phil. Trans.*, 1805, p. 178, and in *Nicholson's Journ.*, 1806, Vol. xiii, No. 50, p. 16 and 56.

† *Mem. de l'Acad. de Petersbourg*, 1809, Tom. i, p. 450, 486.

Joaô Baptista in Brazil *; of M. Arago, in Spain and France †; of M. Freycinet, at Rio Janeiro and in the South Sea; of M. Simonoff ‡, astronomer of the voyage of Bilinghausen, who, during the years 1820 and 1821, observed alone, from hour to hour, more than 4300 barometric heights in the southern hemisphere, between 10° and 30° of latitude; of Captain Sabine, on the western coast of Africa; of MM. Boussingault and Rivero, at La Guayra, and in the Cordilleras of Columbia; and of M. Duperey, commanding the French sloop *la Coquille*, who, in his voyage round the world, touched at Payta on the coast of Peru. In the actual state of the physical sciences, it is no longer necessary to verify by new observations the existence of a phenomenon so generally recognized; we rather engage travellers who cannot in their journies in the interior of a continent, follow the movement of the diurnal variations every half-hour, during several moons, to direct their attention successively to the particular circumstances that accompany, or modify the atmos-

* *Journal von Brasilien*, Tom. i, p. 174; Tom. ii, p. 142.

† See the result of the meteorological observations given by this learned naturalist at the end of every year, in the *Annales de Chimie et de Physique*, from the year, 1816.

‡ Iwan Simonoff, *Beschreibung der Bilinghausischen Entdeckungsreise in das südliche Eismeer*, 1824, p. 33.

pheric tides. Before we ascend to the first causes, we must establish the empirical laws. Those laws comprehend continuity (the want of all irregular interruption), in the movements of ascension, or lowering; the limit-hours or periods of the *maxima* and *minima*; the duration of time that the barometer is apparently stationary; the mean extent of the horary variations in different latitudes and at different heights; the influence of the seasons, or the phases of the moon on the tropical hours, and on the extent of the variations. The observer, who, in any spot on the earth, would throw light on any part of so complicated a phenomenon, must (even in the tropics, where the mean drawn from a small number of statements, furnishes results that are sufficiently exact,) relinquish every other kind occupation. To mark the period and extent of the small successive increase or decrease*, requires continual observation (*observatio perpetua*). The horary variations of the barometer may be compared in

* During the summer solstice, the equinox of autumn, and the winter solstice of 1806, as well as during the spring equinox and the summer solstice of 1807, I made *continued observations* at Berlin, conjointly with M. Oltmanns, and furnished with a magnetic glass of Prony, on the horary variations of the magnetic inclination, during twenty-nine days, and twenty-nine nights, every half-hour. The limits of the errors were 6'' to 8'' in arc.

this respect, to those of the magnetic inclination; and the celebrated astronomer * who alone on the continent of Europe marks the latter, measuring daily, during several hours, the amplitude of the elongations of the magnetic needle, will tell us, in publishing his precious observations, what patience and long assiduity such a species of labor requires. I advise the traveller, when he arrives within the tropics, to certify by observations during a day and night without discontinuing, whether the *epochas of the limits* are effectively, in the spot where he would fix his stay, 21^h-22^h; 4^h-5^h; 10^h-11^h; 15^h-16^h. This previous labor will ascertain for him the periods of the day and night when he must be found near his instrument, in order to occupy himself with the different parts of the problem of horary variations; for instance, to examine, in observing every ten minutes, if the *maximum* be attained at 9^h, or at 9¹/₄^h in the morning; if the mercury remain stationary, and how long a time that state lasts; if the tides of the night are stronger than those of the day, &c.

I. CONTINUITY OF THE MOVEMENTS. What is at first most striking in the phenomenon of the horary variations between the tropics, is the

* M. Arago.

uninterrupted ascending and descending movement. At the periods when the mercury during twenty-four hours, attains the *maximum*, and the *minimum*, m , n , m' and n' , the direction of the movement remains constantly the same, from m to n , and from m' to n' , whatever may be the hours in different places of the earth, to which the concave, or convex summits of the curve of diurnal variations correspond. We scarcely find in thousands of American observations, one or two exceptions to the laws I have ascertained. Accustomed to an uninterrupted regularity, the observer is so much struck by the slightest anomaly, that he is often tempted to attribute it to some negligence in the observation, or the want of perpendicularity in the instrument *. At Cumana, for instance, on account of this continuity of the movements, one day and one night suffice to ascertain the type of the progress of the barometer; while in Europe, we must take the mean, not of a decade, but (as we shall soon shew), at least of twenty or thirty days.

II. *Epochas of the maxima, and the minima.*
Duration of the stationary state. There is something vague in the manner of indicating

* See above, in the observations at Cumana, August 24th and 30th (Vol. vi, p. 666).

the epochas of the limits. We must determine at the same time the moment when the mercury attains its *minimum* and no more changes sensibly, and the moment when the mercury begins again to mount. It happens, as in every thing susceptible of a *maximum* and a *minimum*, that the increase and diminution of the tides of the atmosphere and the ocean, near the extreme limits *, are in proportion to the square of time elapsed since the epochas of the *maxima* and the *minima*. The barometer consequently remains stationary in appearance, before its movement becomes retrograde. This stationary state lasts a longer or shorter time, like the state of the flux of the *sea at low water*. If, at Calcutta, for instance, the heights observed were:

| | inches |
|---------------------------|------------------------|
| at 2 ^h 0'..... | 29,97 (angl. measure.) |
| 2 ^h 30'..... | 29,97 |
| 3 ^h 0'..... | 29,96 |
| 4 ^h 0'..... | 29,96 |
| 5 ^h 0'..... | 29,96 |
| 6 ^h 30'..... | 29,96 |
| 7 ^h 0'..... | 29,97 |
| 7 30'..... | 29,98 |

It may be said, either that the barometer has attained its *minimum* at 3^h, that it kept at the same height till 6^h 30' and then began to re-

* Laplace, *Système du Monde*, 1813, p. 84.

mount; or, (which is more theoretically exact, supposing changes that are unperceived by our senses, and alike rapid on both sides of the summit), we may indicate $\frac{3^h + 6\frac{1}{2}^h}{2} = 4^h 45'$, as the real epocha of the *minimum*. I have learnt from long experience, that there is often more regularity in the period with respect to the hours of the apparent *maximum* and *minimum*, than in the duration of the stationary state. The apparent *minimum* was attained in South America, for instance, very uniformly during whole months, at from 4^h to $4^h 15'$ in the afternoon, but at the same season the barometer rose visibly, sometimes from 5^h , sometimes from $6\frac{1}{2}^h$. I have therefore, in my tables, placed the signs of the *maximum* and the *minimum* (+ and —) near the hours when the mercury appears to have attained the concave and convex summits of the curve. It would have been impossible for me to express by the *half-sum* of *equal heights*, the moment that corresponds theoretically to the real summit, my occupations not having permitted me to do more for discovering the extent of the variations, than observe at the hours when the barometer attains its apparent *maximum*, or *minimum*. According to this remark, the assertion of Dr. Balfour, that the mercury has a prevailing tendency to descend from 10^h in the morning till 6^h in the evening,

is somewhat vague, because the time that the mercury continues to preserve its *maximum* and *minimum* of height, is comprehended in the expressed interval. The tendency of the mercury to descend, or rather the interval between the *maximum* of the morning, and the *minimum* of the afternoon, can only be determined by knowing with precision the half-duration of the stationary states near the limits of 10^h and 4^h.

The observations published at Calcutta being the only ones that have been made during a whole moon, every half-hour, served me to find the difference between the *real* and *apparent maxima*. The following is the *tropical instant*, and the duration of the stationary state, for twenty-seven days.

OBSERVATIONS AT CALCUTTA.

| DAYS. | APPARENT MAXIMA. | REAL MAXIMA. | DURATION. |
|-------|---------------------|--------------------|--------------------|
| 1 | 8 ^h 30' | 8 ^h 45' | 0 ^h 30' |
| 2 | 9 0 | 10 0 | 2 0 |
| 3 | 9 0 | 10 30 | 3 0 |
| 4 | 9 30 | 9 45 | 0 30 |
| 5 | 9 0 | 10 30 | 3 0 |
| 6 | 10 0 | 10 15 | 0 30 |
| 7 | 10 0 | 10 15 | 0 30 |
| 8 | 8 30 | 9 0 | 1 0 |
| 9 | 8 0 | 9 30 | 3 0 |
| 10 | 9 30 | 10 15 | 1 30 |
| 12 | 9 0 | 9 45 | 1 30 |
| 13 | 9 30 | 10 30 | 2 0 |
| 14 | 9 30 | 10 30 | 2 0 |
| 15 | 10 0 | 10 30 | 1 0 |
| 16 | 8 0 | 10 45 | 5 30 |
| 17 | 9 0 | 9 30 | 1 0 |
| 18 | 8 0 | 8 30 | 1 0 |
| 19 | 9 0 | 9 30 | 1 0 |
| 20 | 10 0 | 10 15 | 0 30 |
| 21 | 11 30 | 11 45 | 0 30 |
| 22 | 9 0 | 10 0 | 2 0 |
| 23 | 10 0 | 10 45 | 1 30 |
| 24 | 10 30 | 10 45 | 0 30 |
| 25 | 10 0 | 10 45 | 1 30 |
| 26 | 9 0 | 10 0 | 2 0 |
| 27 | 8 30 | 9 45 | 2 30 |

It results from this table, that, even in the places where, near the extremity of the equinoxial zone, the horary variations become less regular than at Cumana, the epocha of the *maximum* does not vary as much as the duration of the stationary state. We find for Calcutta :

| | |
|---------------------------|--------------------|
| Mean of the app. max..... | 9 ^h 17' |
| of the real max..... | 10 5 |
| of duration..... | 1 36 |

Now, the variations of the *apparent maximum* are separated from the mean, more than eighteen minutes of time, fourteen times on twenty-six ; while the same separation of 18' is found in the duration of the stationary state, nineteen times. The epochas at Calcutta of the *apparent maxima* and *minima* are, employing the observations of a whole month, 9^h 15' in the morning, 2^h 36' afternoon, 9^h 32' of the evening, and 3^h 12' of the morning. The *real maxima*, that is the real epochas of the *maxima*, succeed nearly an hour to the *apparent maxima*.

Are the epochas of the extreme limits, which we have called, with M. Ramond, the *tropical hours* *, the same over all the earth? That

* *Wendestunden*, hours in which the movement *returns* on itself, and which must not be confounded with the hours of the *tropical* or *equinoxial year*.

question, in the present state of our knowledge, cannot be completely solved. We know generally only the *apparent*, and not the *real* epochas; even the former are not always indicated with sufficient precision. Travellers have observed the *maxima* and the *minima*, as it were by chance, sometimes at the moment when the limits were attained, sometimes an hour later, and while the barometer was in a stationary state. The numerous observations of M. Ramond prove that, in the temperate zone, in 45° and 46° of latitude, the *tropical hours*, or *limit-hours*, change from summer to winter, and that the two points of the diurnal *maximum* and *minimum*, draw nearer noon in proportion as the cold augments*. We are yet ignorant whether similar changes do not precede, in a part of the torrid zone, (at Quito and Bombay, for instance,) the epocha when, under the influence of local circumstances, in the rainy season, it is said, that the regular type of the horary variations has altogether disappeared. We cannot too much recommend this point to the researches of travellers. I shall here note what I have hitherto collected with most certainty on the epocha of the *maxima* and the *minima*.

* *Mem. de l'Inst.*, 1808, p. 103. (*Bibl. Universelle, Février, 1824*, p. 93.)

A. *Within the tropics, or near their limits.* A new revision of all the observations I had made, north and south of the equator, in Spanish America, from 23° north latitude, to 12° south latitude, in the low regions of the steppes, and forests, and on the back of the Cordilleras, where the mean temperature is equal to that of the north of Europe, has not obliged me to modify the results which I published in the *Physical Table of the equatorial regions*. I every where observed that the barometer attains its *maximum* at 9^{h} or $9\frac{1}{4}^{\text{h}}$ in the morning; that it descends slowly till noon, but rapidly from noon till $4\frac{1}{2}^{\text{h}}$; that it re-ascends till 11^{h} at night, when it is a little lower than at 9^{h} in the morning; that it sinks slowly all night till 4^{h} in the morning, and again rises till 9^{h} . The duration] of the stationary state was so short at Caraccas, Cumana, and Mexico, that, for the *maximum* of the morning, for instance, the mean of my observations yields, *real epocha*, $9^{\text{h}} 20'$; *apparent epocha*, $9^{\text{h}} 5'$. I passed a great number of days near the instrument at the tropical hours, in order to ascertain if they were rather 9^{h} than $9\frac{1}{4}^{\text{h}}$; rather 4^{h} than $4\frac{1}{2}^{\text{h}}$; and I observed, as I have already said, that in some places of the torrid zone, the moment when the pressure of the air begins to diminish is so marked, that the barometer indicates the real time within a quarter of an hour. When the

duration of the stationary state near the limits is almost null, as at Cumana, the changes are announced when the limit is attained, by a change in the convexity of the column of mercury. The variations appear to be independent of those of the temperature and the seasons. If the mercury was descending from 2^h till 4^h, or rising from 4^h till 11^h, a violent storm, an earthquake, showers, and the most impetuous winds, would not alter its movement; which nothing appears to determine but the real time, or the position of the sun. The regularity of the variations was constant in the rainy season, both in the thick forests of the Atabapo, and on the table-land of Pasto (1600 toises) and of Mexico. When the duration of the stationary state was prolonged, it was most frequently at 4^h in the afternoon, and from 4^h till 9^h in the morning. At Lima, the *maximum* of the evening oscillated from 9½^h to 11½^h. The observations I made at 4^h in the morning are, unfortunately, the least numerous. The only place where during the course of my voyage I remarked a great deviation, is the town of Quito, situated in a narrow valley, and close to the volcano of Pichincha. I could only make observations in this valley during the months of January, February, and March, where the *maximum*, in very variable and rainy weather, was rather near noon, than at 9^h in the morning, and where

the barometer continued to descend without interruption from noon till midnight. If the variations were alike irregular at the foot of Pichincha, during the whole year, the type of those variations would probably not have been ascertained by M. Godin. I regret not having watched often enough at night at Quito, to judge of the nocturnal tides; but the recent observations which M. Duperrey, commanding the French sloop *la Coquille*, has collected in his voyage round the world, prove, that, south-west of Pichincha, at the point of Payta (lat. $5^{\circ} 5'$ south), the *epochas of the limits* are very regularly, in the month of March, 9^h in the morning and 3^h in the afternoon, 11^h in the evening, and 3^h in the morning. This result is drawn from a fine series of observations made every fifteen minutes during six days and six nights, with a barometer of Fortin. The following table, indicating the hundredths of millimetres, and the degrees of the centesimal thermometer, is extracted from a manuscript journal, kindly communicated to me by M. Arago.

OBSERVATIONS AT PAYTA, IN 1823.

| DAYS | HOURS. | BAROMETER. | THERMOMETER. |
|-------------|------------------|------------|--------------|
| 12th March. | 6 | 762.20 | 25.0° |
| | 7 | 762.40 | 25.3 |
| | 8 | 762.40 | 25.9 |
| | 8 $\frac{1}{4}$ | 762.70 | 26.7 |
| + | 8 $\frac{3}{4}$ | 762.80 | 26.7 |
| | 9 | 762.70 | 27.2 |
| | 10 | 762.50 | 26.8 |
| | 11 | 762.10 | 26.9 |
| | noon. | 761.50 | 28.2 |
| | 2 | 759.80 | 28.7 |
| | 3 | 759.20 | 29.1 |
| - | 4 | 759.20 | 28.8 |
| | 5 $\frac{1}{4}$ | 759.20 | 27.6 |
| | 6 | 759.30 | 27.7 |
| | 9 | 761.40 | 26.9 |
| | 10 | 762.30 | 26.7 |
| | 10 $\frac{3}{4}$ | 762.30 | 26.3 |
| + | 11 | 762.40 | 26.2 |
| | 11 $\frac{1}{4}$ | 762.20 | 26.1 |
| | midnight. | 762.30 | 26.0 |
| 13th March. | 1 | 761.30 | 25.8 |
| | 2 | 761.10 | 25.5 |
| - | 2 $\frac{1}{4}$ | 760.70 | 25.3 |
| | 3 | 760.80 | 25.3 |
| | 4 | 761.20 | 25.3 |
| | 5 | 761.50 | 25.6 |
| + | 9 $\frac{1}{4}$ | 762.30 | 27.0 |
| | 10 | 762.20 | 26.8 |
| | noon. | 761.20 | 29.5 |
| - | 2 $\frac{3}{4}$ | 759.80 | 30.9 |
| | 4 | 759.80 | 30.5 |
| | 5 | 760.00 | 30.4 |
| | 10 | 761.60 | 27.3 |
| + | 11 | 769.50 | 27.4 |
| | midnight. | 762.80 | 26.4 |

In comparing the hours of the *maxima* and the *minima* in different zones, we must not confound the observations that are made in circumstances altogether different. We must distinguish the places where, during the whole year, in the time of drought, as well as of rains, the barometer furnishes a regular periodic movement; and the places where, during the rainy season and *monsoons*, this movement is interrupted or rendered insensible. According to Thibault de Chanvalon, the influence of these causes is not observed * at Martinique; I remarked it on the continent of Spanish America, only at Quito, in the month of April, and at Vera Cruz, when the north wind blows with the greatest violence. Dr. Cassan asserts, that he found great irregularity in the island of Saint Lucia, south of Martinique. “We have observed,” he says†, “with great care the famous variation of the barometer, which is independent of the apparent constitution of the atmosphere, and has been celebrated by Godin and Chanvalon. The periodical movement of ascension and lowering, takes place, no doubt, twice in twenty-four hours; but the hour of the movement appeared to me much less regulated than is pretended.” This assertion of Dr.

* *Voyage à la Martiniqne*, p. 135 (25).

† *Journal de Phys.*, 1790, Tom. 36, p. 268.

Cassan loses its importance, when we recollect how little precision this naturalist generally observes in his labors. He does not admit that the movements of the mercury, even in their irregularity, correspond perfectly with the movements of the Ocean on the western coast of Saint Lucia; he pretends also "that the barometric formula used in Europe cannot be applied to the measure of the height of the mountains situated in the tropics." The few observations that have hitherto been published on the horary variations in the island of Saint Domingo * might lead us to suspect inequalities which would only disappear by employing the *mean*; but it is to be feared that travellers, by not observing from hour to hour, have confounded either the different epochas of the stationary state of the barometer, or the effects of the rainy season, and of that of drought. An observer in India, who merits the highest confidence, M. Horsburgh, has made very curious remarks on the climateric and local circumstances, which sometimes mask, or alter the type of the amospheric tides, even in the torrid zone. He saw that the rains at Bombay interrupted the period altogether; but that a tendency

* Chanvalon gives for the limit-hours + 22; — 6; + 10; Moreau de Saint Mery: + 23; — 3; M. Moreau de Jonnès, + 21; — 2; + 7; — 13. (*Hist. Phys. des Ant. Franc.*, Tom. i, p. 417.)

to regularity is observed, whenever, even for some hours only, the weather begins to grow clear. In the same season, and in the same latitude, the atmospheric tides are very sensible in the open sea, while the *periodicity* disappears on the coast *. M. Horsburgh also observed, that the high lands that bound the strait of Sincapore (a pass of small breadth) suffice to mark the regularity of the horary variations.

It may appear surprising that at the foot of the Cordilleras of Venezuela, New Granada, Quito, and Mexico (at Cumana, La Guayra, Calabozo, Guayaquil, Payta, Lima, and Vera Cruz), the variations attain their extreme limits at the same hours as in the high vallies and table-lands of Caraccas, Santa Fe de Bogota, and Popayan (between 500 and 1400 toises); while in India the configuration of the lands modify in a very striking manner the phenomenon of the atmospheric tides. This difference between America and a small part of equinoxial Asia, appears to arise from climateric circumstances; almost every where between the tropics, the same wind (E.N.E. or E.S.E.) brings layers of air of the same temperature; but in India, the variable *monsoons* occasion extraordinary gusts against the elevated parts of the land. Their effects are not felt far from the

* *Nicholson's Journ.*, Vol. xiii, p. 20.

coast, for M. Horsburgh found at sea, in the latitudes of India and China, an uninterrupted barometric *periodicity*, at all seasons. It is, above all, in studying the position of places, where the deviations of the type are manifested, that the cause which produces the regularity of the atmospheric tides will be made clear.

Since my departure from Lima, the professor Don Hipolito Unanue, and the American Captain Samuel Curson, found, on the coast of Peru and Chili, the same hours of the *maximum* and *minimum* that are indicated in the preceding tables (Vol. vi, p. 670); but M. Unanue informs me, that “these hours appear to change in ascending the Cordilleras of Peru; and that this delay, in the epochas of the extreme limits, appears to him to be owing to the winds which blow differently on the coast of the Pacific Ocean, and in the narrow vallies of the Andes.” I do not doubt the possibility of those changes of epochas; but no naturalist has hitherto published a series of observations which indicates them in a regular manner. The question is, whether the winds and rains (as during a part of the year at Bombay and Canton), disarrange the movement of the barometer, so that no type of regularity can be ascertained; or, (which is very different) whether places exist in the equatorial zone, where always, or at one season only, atmospheric tides

are remarked, of which the epochas of *maxima* and *minima* swerve regularly (more than two hours for instance), from the period of 4^h till 9^h in the morning, and from 4^h till 10½^h in the evening? The table placed at the end of this memoir will shew that in the only parts of the earth where a sufficient number of observations have been made to furnish with precision the hours when the variations attain the extreme limits, nearly thirty observers have found a striking accordance * in the return of the same epochas.

Places where it has been often too lightly asserted that the periodicity of the atmospheric tides is irregular, have been discovered, after mature examination, to present the greatest regularity in the epochas of the *maxima* and the *minima*. M. d'Eschwege found those epochas precisely similar to those of Cumana, in the low and hot part of Brazil, bounded by the two chains of the Espinhaço and the shore †, for instance at San Joaõ Baptista, in the missions of the Caroatos Indians; while, on the contrary, at Villarica and Rio Janeiro, the type

* An excellent observer, Mr. Colebrooke, affirmed very recently, that even in the interior of India, in most places the periodicity is manifest and independent of the variations of the temperature, and the season of the year. *Asiat. Res.*, Vol. xii, p. 266.

† See above, Vol. vi, p. 531.

appeared to be marked by causes of perturbation. We now know that this assertion demands some restriction for Rio Janeiro. M. de Freycinet, who stopped at this port in his last voyage round the world, found in the month of August, consequently in more serene weather, the greatest regularity in the horary variations*.

OBSERVATIONS AT RIO JANEIRO, IN 1820.

| HOURS OF THE OBSERVATIONS. | HEIGHTS OF THE BAROME- TER in hun- dredths of millimeter. | HOURS OF THE OBSERVATIONS. | HEIGHTS OF THE BAROME- TER in hun- dredths of millimeter. |
|-------------------------------|---|-------------------------------|---|
| 11..... | + 766.71 | 23..... | 766.65 |
| midnight.... | 766.77 | noon..... | 765.96 |
| 13..... | 766.59 | 1..... | 765.76 |
| 14..... | 766.15 | 2..... | 766.04 |
| 15..... | - 765.65 | 3..... | 764.28 |
| 16..... | 765.67 | 4..... | 764.28 |
| 17..... | 765.78 | 5..... | 764.49 |
| 18..... | 766.00 | 6..... | 764.43 |
| 19..... | 766.35 | 7..... | 765.33 |
| 20..... | 766.49 | 8..... | 764.69 |
| 21..... | + 766.91 | 9..... | 766.38 |
| 22..... | 766.96 | 10..... | 766.55 |

* Barometer of Fortin. The heights are reduced to the temperature of zero. If we would have them corrected of the error of the level, it would be necessary to add 0^{mm},922.

These results are even confirmed by older observations than those of Lamanon. M. Sanchez Dorta has published in the greatest detail, in the first volume of the *Memoirs of the Academy of Lisbon*, the barometric heights observed at Rio Janeiro, at three periods of the day, (morning, noon, and evening) during the whole year of 1785. In this table, of more than a thousand observations*, we scarcely find two or three days in a month where any irregularity is remarked; but the hours indicated not being precisely those of the extreme limits, it is better to have recourse to the table in which M. Dorta gives for every month the mean of the hours 18^h, 20^h, 22^h, 24^h, 2^h, 4^h, 6^h, 10^h.

* *Mem. da Academia Real das Sciencias*, 1799, Vol. i, p. 397. The barometer was of the construction of M. de Magalhães.

OBSERVATIONS AT RIO JANEIRO, IN 1785.

| MONTHS. | 6 ^h in the morning. | 8 ^h in the morning. | 10 ^h in the morning. | noon. | 2 ^h after-noon. | 4 ^h after-noon. | 6 ^h in the evening. | 10 ^h in the evening. | MEAN TIME, FARR. | |
|--------------|--------------------------------|--------------------------------|---------------------------------|-------|----------------------------|----------------------------|--------------------------------|---------------------------------|-----------------------------|---------------------------|
| | | | | | | | | | at 10 ^h morning. | at 4 ^h aftern. |
| January - - | 1.83 | 2.10 | 2.22 | 1.96 | 1.63 | 1.26 | 1.65 | 2.30 | 81.1 | 83.6 |
| February - | 1.62 | 1.87 | 2.12 | 1.86 | 1.67 | 1.30 | 1.61 | 2.15 | 79.4 | 81.9 |
| March - - - | 2.57 | 2.93 | 3.18 | 2.88 | 2.54 | 2.28 | 2.59 | 3.00 | 76.1 | 77.4 |
| July - - - - | 4.02 | 4.31 | 4.65 | 4.30 | 3.93 | 3.69 | 3.98 | 4.44 | 66.7 | 70.4 |
| August - - - | 4.48 | 4.74 | 5.06 | 4.68 | 4.40 | 4.18 | 4.43 | 4.73 | 71.2 | 74.7 |
| September | 3.68 | 3.98 | 4.22 | 3.89 | 3.49 | 3.33 | 3.66 | 4.13 | 71.7 | 73.9 |

The barometric heights* are indicated in this table in hundredths of lines (antient measure of the French foot). In order to disengage them from the influence of the temperature, or reduce them to the freezing point, I have added the mean temperature of the limit-hours in which the mercury attains the *maximum* and the *minimum*. The periodical movement of the horary variations at Rio Janeiro are, as every where else, where the mean of well-made observations can be taken, of the greatest regularity. Nor would it have been extraordinary if among 1095 partial observations, published by M. Dorta for the year 1785, more numerous anomalies had been found; for Rio Janeiro (lat. $22^{\circ} 54'$) is like the Havannah (lat. $23^{\circ} 9'$), Calcutta (lat. $22^{\circ} 34'$), Canton (lat. $23^{\circ} 8'$) and Macao (lat. $22^{\circ} 12'$), near the limit of the torrid zone, where the perturbing influence of the temperate zone begins to be felt.

The doubts thrown on the regularity of the horary variations of the coast of Brazil, are spread still more to the east, as far as Macao, a spot situated at an equal distance from the equator, in the northern hemisphere. A series

* We must add twenty-eight inches to every height, so that the mean height of the barometer at Rio Janeiro, at 10^h in the morning, in the month of July was 28ⁱⁿ 4^{li}.
65.

of very valuable observations* made during three years by the Abbé Richenet, of the congregation of Saint Lazare, proves, that on the southern coast of China, the atmospheric tides display the most admirably constancy, and that their period is ascertained day by day, without the necessity of having recourse to the mean. I shall choose the driest month (January), in which there was not one day of rain, and the most humid month (June), in which twenty days of rain yielded 732 millimetres of water†.

* These unpublished observations, of which I owe the communication to the kindness of Lord Strathallan, who long resided at Canton and at Manilla, were made with two barometers of English construction, with a thermometer of *maxima* of Six, and with an hygrometer of Saussure. The barometric heights, in hundredths of an English inch, are not corrected by the temperature.

† Quantity of water fallen at Macao in 1814, in one hundred and fifty-four days of rain, of which thirty-six were accompanied by thunder : 7^{ft} 7.6ⁱⁿ English measure.

OBSERVATIONS AT MACAO, IN 1814.

| JANUARY. | BAROMETER. | | | THERMOMETER. | | JUNE. | BAROMETER. | | | THERMOMETER. | |
|----------|---------------------------------|--------------------------------|---------------------------------|--------------|-----------|-------|---------------------------------|--------------------------------|---------------------------------|--------------|-----------|
| | 10 ^h in the morning. | 5 ^h in the evening. | 10 ^h in the evening. | maxim. F. | minim. F. | | 10 ^h in the morning. | 5 ^h in the evening. | 10 ^h in the evening. | maxim. F. | minim. F. |
| 1 | 30.35 | 30.24 | 30.25 | 72 | 66 | 1 | 30.07 | 30.00 | 30.01 | 83 | 79 |
| 2 | 30.26 | 30.21 | 30.24 | 73 | 67 | 2 | 30.08 | 30.06 | 30.14 | 83 | 80 |
| 3 | 30.34 | 30.28 | 30.30 | 74 | 67 | 3 | 30.18 | 30.16 | 30.22 | 80 | 78 |
| 4 | 30.39 | 30.28 | 30.32 | 73 | 69 | 4 | 30.25 | 30.18 | 30.23 | 80 | 71 |
| 5 | 30.34 | 30.28 | 30.33 | 75 | 70 | 5 | 30.12 | 30.11 | 30.11 | 82 | 77 |
| 27 | 30.32 | 30.27 | 30.30 | 71 | 65 | 26 | 29.89 | 29.79 | 29.84 | 84 | 82 |
| 28 | 30.35 | 30.32 | 30.34 | 70 | 67 | 27 | 29.83 | 29.82 | 29.85 | 81 | 78 |
| 29 | 30.41 | 30.32 | 30.33 | 72 | 67 | 28 | 29.87 | 29.83 | 29.88 | 83 | 78 |
| 30 | 30.29 | 30.18 | 30.19 | 72 | 68 | 29 | 29.84 | ..... | 29.82 | 82 | 78 |
| 31 | 30.18 | 30.13 | 30.14 | 74 | 68 | 30 | 29.77 | 29.73 | 29.78 | 84 | 79 |

The regularity of the variations marked in the preceding table, are found in more than a thousand heights, which I carefully examined on the registers of the Abbe Richenet. During the course of the whole year 1814, the centigrade thermometer descended at Macao in January, to 5° below the freezing point; it rose at the end of August, to 30.4° . There were frequent tempests, and thirty-six stormy days; more than 2.316 of rain water fell, and amidst so many climateric changes, I did not remark one single period of seventeen hours during which the ascending and descending movements of the barometer (from 5^h in the morning to 10^h , from 10^h to 5^h in the afternoon, and from 5^h till 10^h in the evening) had been interverted.

On the east of Macao, in the South Sea, MM. de Langsdorf, Horner, and Simonoff found, by a mean drawn from 5700 horary observations, the limit-hours nearly the same, namely: M. de Langsdorf, taking the mean for the north and south torrid zone $+ 9^h 40'$ in the morning; — $3^h 55'$ afternoon; $+ 10\frac{1}{2}^h$ in the evening; — $3\frac{1}{2}^h$ after midnight: M. Simonoff, in taking the mean for the space contained between the parallels of 10° and 30° south latitude: $+ 9^h 24'$ in the morning; — $3^h 24'$ in the afternoon; $+ 9^h 30'$ in the evening; and — $3^h 18'$ after midnight. The Russian astronomer made observations in the equinoxial region of the At-

lantic Ocean, nearly in the same latitudes as Lamanon: but the observations of the latter being much more numerous (extending from $22^{\circ} 55'$ south lat. to 26° north lat., and corresponding with every hour comprised in 32 days and 32 nights), the results to be drawn from them appear to be more worthy of confidence. M. Simonoff stops at $+ 9^{\text{h}} 39'$ in the morning; — $3^{\text{h}} 23'$ afternoon; $+ 9^{\text{h}} 47'$ in the evening; — $3^{\text{h}} 25'$ after midnight. These epochas of the *maxima* and the *minima*, determined by the mean with extreme precision, and by the observer, prove, that notwithstanding a difference of 140° of longitude, the atmospheric tides follow the same hours* within 18 minutes, in the equinoxial regions of the South Sea, and the Pacific Ocean.

B. *In the temperate zone.* When I endeavoured, in the physical table of the equatorial regions†, to call the attention of the learned of Europe to

* This regularity or correspondence of epochas east and west of America, is no doubt very striking; but to disengage the *Atlantic results* of M. Simonoff from the influence of the temperate zone, where he passed from 24° to 26° north latitude; I calculated, on the registers which he confided to me, only the observations made between $8^{\circ} 26'$ south lat. and $8^{\circ} 22'$ north lat. In that extent of the Atlantic, I find $+ 9^{\text{h}} 42'$ in the morning, — $3^{\text{h}} 30'$ afternoon, $+ 9^{\text{h}} 48'$ in the evening; — $3^{\text{h}} 2'$ after midnight.

† See my essay on the geography of plants, 1807, p. 94.

the study of the atmospheric tides, I ventured to predict that "in the temperate climates, where the horary variations of the weight of the air are concealed beneath a multitude of local causes that make the barometer rise and fall irregularly, the *mean*, drawn from a great number of observations made from hour to hour, proves that, in the high latitudes, like those of the torrid zone, the mercury rises and sinks at determinate epochs." That proof, thanks to the zeal of naturalists, has been completely obtained. We shall follow the variations of the tropics towards the temperate zones. M. Simonoff has observed that the hours of the *maxima* and the *minima* are manifested by partial observations, and without having recourse to the mean, in the Pacific Ocean, between the tropic of Capricorn, and the 30° of the south latitude; and in the Atlantic Ocean, between the tropic of Cancer, and the 26° of north latitude. If the greater extension of the *tropical climate* in the southern hemisphere, be confirmed by other travellers, it will be linked with many phenomena which the temperature, the trade-winds, and the vegetation of monocotyledon arborescent plants, present. Mr. Horsburgh found on the east of Africa, in the seas of India and China, that the variations were more regular, and greater, from 10° north lat. to 25° south lat., than from 10° to 20° north of

the equator. M. Leopold de Buch, in his voyage to the Canary Islands, obtained, after twenty days of barometric observations at Las Palmas, in the Gran Canaria, for the extreme limits, 10^h and 11^h in the morning, 4^h in the afternoon, and 11^h in the evening *. M. Coutelle, during the course of the meteorological observations, which he was charged by the Institute of Egypt to make at Cairo, in 1799, 1800, and 1801, did not know the periodicity of the variations of the barometer between the tropics; but a few weeks sufficed to shew him that at all seasons, in $30^\circ 3'$ of north lat., the mercury rises from 5^h to $5\frac{1}{2}^h$ in the morning, till 10^h and $10\frac{1}{2}^h$; that it descends regularly till 5^h or $5\frac{1}{2}^h$ in the afternoon; that it remounts till 10^h or $10\frac{1}{2}^h$ in the evening, and again descends till 5^h or $5\frac{1}{2}^h$ in the morning †. In our more northern regions of Europe, Van Swinden ‡, Chiminello §, Duc la Chapelle ** and Hemmer ††, had remarked during forty years, with more or less certainty,

* *Einige Bemerkungen uber das klima der Canarischen Inseln*, p. 9.

† *Description de l'Egypt, Mem. d'Hist. nat.* Tom. ii. p. 335.

‡ *Journ. de physique*, 1778, Tom. xii. p. 301.

§ *Saggi scientifici di Padova*, 1786, Tom. i. p. 46.

** *Bulletin des Sciences*, an 7, n. 2, p. 162.

†† *Gren, Journ. der Physik.*, B. ii. p. 223. (*Ephemerides Manheim* 1783 and 1789.)

that the barometric variations were subject to certain laws. Van Swinden announced in the year 1776, the existence of a diurnal period: he employed the method of the *mean*, to exclude the effects of accidental perturbations; but he fixed hours for the *maxima* and *minima* ($+1\frac{1}{2}^h$; -6^h ; $+10^h$; -22^h astronomic time), which, according to the position of Franecker, and the analogy of the observations of Koenigsberg, appear little probable. Cotte*, Hemmer, Planer, and other members of the Meteorologic Society of Mannheim, ascertained that the passage of the Sun over the meridian, tended to make the barometer descend, and that that instrument was generally lower at 2^h in the afternoon, than in the morning and evening. Duc la Chapelle carefully observed the more or less swelled convexity of the column of mercury, and concluded from his labors, that the barometer lowers in the south of France, from 7^h in the morning till $2\frac{1}{2}^h$ in the afternoon; that it rises till $10\frac{1}{2}^h$ in the evening, and again descends rapidly during the night. All these assertions were vague and contradictory: the first precise observations made in Europe on the horary variations of the barometer, were by M. Ramond. "I obtained," says that excellent observer †, "analagous results to

* *Journ de phys.*, Tom. xxxvii, p. 104.

† *Mem. de l'Institut pour l'année 1803*, p. 100, 103 and 107.

those of M. de Humboldt at the equator, but the hours of variation differ according to the seasons ; the *tropical hours* for winter, are at 9^h in the morning, 9^h in the afternoon, and 9^h in the evening. In summer the lowering appears to begin at 8^h in the morning, is continued till 4^h in the afternoon, and begins again at 10^h in the evening. My observations being made alone, it was impossible for me to determine the nocturnal variations with sufficient precision ; for in our climates, whole months of assiduous observation do not suffice to limit the quantities which one single night of the equator furnishes in all their purity."

All the remarks of M. Ramond on the epochas of the extreme limits, and the small changes which these epochas undergo in winter and summer, have been perfectly confirmed by the observations made from 1817 to 1821, at Toulouse, by M. Marqué Victor, and from 1822 to 1823, at Chambery, by M. Billiet. The former collected more than 20,000 barometric heights, of which the results are inserted in the *compte rendu* of the labors of the Academy of Toulouse. He observed from six in the morning till midnight, from hour to hour, with extraordinary assiduity and patience. At Toulouse, as at Chambery, and at Clermont in Auvergne, the diurnal *maxima* and *minima* draw nearer to noon more than an hour, in winter, when the

sun rises later; but the type * of summer ($+20^h$; $-4\frac{1}{2}^h$; $+10^h$) is almost identical in Europe with that which I ascertained in the torrid zone ($+20^h$; $-4\frac{1}{2}^h$; $+11^h$). It would be interesting to know if this analogy holds at the epocha of the *minimum* which takes place after midnight ($16\frac{1}{2}^h$), an epocha for which numerous statements are wanting in our climates.

A traveller who has devoted himself with success to the measurement of mountains, M. de Parrot †, asserts, from a series of observations which he made every half-hour, during 14 days and 14 nights, that at Milan, the *epochas of the limits* are: -18^h ; $+23^h$; $4\frac{1}{2}^h$; $+12^h$. It cannot be doubted that, in studying the tables of the horary variations of the barometer, published nine years ago by M. Arago, and which I regard, on account of the perfection of the in-

* The type of the winter in Europe, taking the mean between the horary observations of MM. Ramond, Marque Victor, and Billiet, appears to be $+21\frac{3}{4}^h$; $-2\frac{3}{4}^h$; $+9\frac{3}{4}^h$. The differences presented by the *epocha of the limits* in winter and in summer seem to prove, that the most proper hours for observers of the barometer, in our observations in Europe, are (if we would wish them to be uniform for the whole of the year), $9\frac{1}{4}^h$ in the morning; $3\frac{1}{2}^h$ afternoon; and $10\frac{1}{4}^h$ at night. The *minimum* of the morning in Europe seems to fall between 3^h and 4^h after midnight.

† *Reise in den Pyrenæen von Freidrich von Parrot*, 1823, p. 11. This *maximum* of the morning (one hour only before midnight) appears to me very late.

strument, and the choice of the hours (21^h and 4^h), as the most instructive which we hitherto possess, the mean of the two decades suffices to shew that the mercury sinks between 9^h in the morning, and 4^h in the afternoon; but in order to determine the quantity of variations, to know if the *maximum* is attained at 9^h or at 11^h, requires more days of observation in the temperate zone than M. Parrot could devote at Milan.

III. *Extent of the horary variations.* In collecting the whole of my observations at Cumana, I find, for that part of the tropics, and at the level of the sea, the extent of the variations reduced to zero of temperature, from 9^h in the morning till 4^h in the afternoon, to be 1.10^{li} or 2.47^m. I shall add to the results of Cumana those of Caraccas, corresponding to an elevation of 408 toises.

ATMOSPHERIC TIDES OF THE MORNING AT CARACCAS.

| DAYS. | MAXIMUM of the morning in lines. 9h. | THERMOMETER OF REAUMUR. | MINIMUM afternoon in lines. 4h. | THERMOMETER OF REAUMUR. | APPARANT DIFFERENCE. | REAL DIFFERENCE reduced to zero. |
|-----------|---|-------------------------------|--|-------------------------------|-------------------------|---|
| 30th Nov. | 304.21 | 15° | 303.00 | 17° | 1.21 | 1.34 |
| 1st Dec. | 304.03 | 16 | 303.00 | 18 | 1.03 | 1.16 |
| 2 — | 304.90 | 16 | 303.10 | 17 | 1.80 | 1.87 |
| 3 — | 304.40 | 15 | 303.12 | 18 | 1.28 | 1.48 |
| 4 — | 304.40 | 15 | 303.00 | 18 | 1.40 | 1.60 |
| 5 — | 304.32 | 16 | 303.70 | 17 | 0.62 | 0.69 |
| 6 — | 304.20 | 16 | 303.00 | 17 | 1.20 | 1.27 |
| 7 — | 304.40 | 16 | 303.00 | 16 | 1.40 | 1.40 |
| 20 — | 303.80 | 15 | 302.73 | 16 | 1.07 | 1.14 |
| 21 — | 303.70 | 15 | 302.54 | 17 | 1.16 | 1.30 |
| 22 — | 304.00 | 16 | 302.54 | 18 | 1.46 | 1.60 |
| 23 — | 303.55 | 16 | 302.75 | 18 | 0.80 | 0.94 |
| 24 — | 304.20 | 15 | 302.94 | 17 | 1.26 | 1.40 |

ATMOSPHERIC TIDES OF THE MORNING AT CUMANA.

| DAYS. | MAXIMUM of the morning in lines. | THERMOMETER OF REAUMUR. | MINIMUM afternoon in lines. | THERMOMETER OF REAUMUR. | APPARENT DIFFERENCE. | REAL DIFFERENCE reduc'd to zero. |
|------------|--|-------------------------------|-----------------------------------|-------------------------------|-------------------------|--|
| 17th July. | 337.62 | 17° | 336.52 | 21° | 1.10 | 1.40 |
| 18 — | 337.71 | 20 | 336.53 | 22 | 1.18 | 1.18 |
| 19 — | 338.42 | 22 | 336.80 | 24 | 1.62 | 1.77 |
| 20 — | 337.74 | 19 | 336.83 | 23 | 0.91 | 1.21 |
| 21 — | 337.82 | 20 | 336.95 | 23 | 0.87 | 1.10 |
| 22 — | 337.62 | 19 | 337.03 | 23 | 0.59 | 0.89 |
| 16th Aug. | 336.80 | 22 | 335.90 | 23 | 0.90 | 0.98 |
| 17 — | 336.85 | 20 | 335.92 | 22 | 0.93 | 1.08 |
| 18 — | 337.12 | 18 | 336.24 | 23 | 0.88 | 1.26 |
| 21 — | 337.12 | 19 | 336.40 | 23 | 0.72 | 1.02 |
| 22 — | 336.90 | 20 | 336.00 | 21 | 0.90 | 0.98 |
| 23 — | 336.85 | 21 | 336.50 | 23 | 0.35 | 0.50 |
| 24 — | 337.05 | 23 | 336.80 | 24 | 0.25 | 0.33 |
| 25 — | 337.50 | 19 | 336.40 | 22 | 1.10 | 1.33 |
| 26 — | 337.18 | 19 | 336.51 | 23 | 0.67 | 0.97 |
| 27 — | 336.95 | 19 | 336.15 | 20 | 0.80 | 0.88 |
| 28 — | 336.76 | 20 | 336.75 | 25 | 1.01 | 1.39 |
| 29 — | 336.75 | 21 | 335.72 | 24 | 1.03 | 1.26 |

M. Boussingault, in transmitting to me for the Academy of Sciences, the observations of the horary variations made during a whole year, conjointly with M. Rivero, at Santa Fe de Bogota, speaks as follows of the limit-hours : “ It is a fact established by your labors, and verified by ours, that the mercury between the tropics attains its *maximum* between 8^h and 10^h in the morning ; then descends till near 4^h, and is at the *minimum* between 3^h and 5^h in the afternoon ; that it then ascends till 11^h at night, without reaching, however, the same height at which it was at 9^h in the morning ; and finally, re-descends till 4^h in the morning, without going as low as it was at 4^h in the afternoon. In consulting the whole of our observations made at Santa-Fe de Bogota, in 1823 and 1824, (and there are more than 1200 of them), we remark that the greatest height observed, took place July 16th 1824, at 9^h in the morning : it was reduced to the temperature of zero, of 0.56388^m. The smallest height was observed Nov. 5th, 1823, at 4^h in the evening : it was 0.55768^m. During whole months the barometric heights observed at the same hours, at Bogota, do not differ 0.4^m ; and the mercury in the space of a whole year, only oscillated at the epocha of the *maximum* of 9^h in the morning, between 0.55928^m, and 0.56388^m ; and at the epocha of the *minimum* of 4^h in the evening,

between 0.55768^m , and 0.56185^m . These are the extreme oscillations." M. Boussingault found the tides at Bogota, from the 4th to the 5th of January, 1824, as follows: (16^h) 560.70^{mm} ; (17^h) 561.00 ; (21^h) 562.75 ; (22^h) 562.75 ; (23^h) 562.65 ; (noon) 562.30 ; (1^h) 561.60 ; (2^h) 561.25 ; (3^h) 560.80 ; (4^h) 560.50 ; (5^h) 560.65 ; (6^h) 561.10 ; (7^h) 561.55 ; (9^h) 562.60 ; (10^h) 562.75 .

M. Arago has submitted to a new examination the observations made by MM. Boussingault and Rivero in November 1822, at the port of La Guayra, almost in the meridian of Caraccas. In reducing these observations to zero of the centigrade thermometer, he finds that from the 23rd November to the 7th December, the mean of 9^h in the morning was equal to 760.05^{mm} ; that of 10^h , to 760.03^{mm} ; that of 4^h in the evening, to 757.44^{mm} ; and that consequently, the mean diurnal variation was 2.44^{mm} . The partial differences of the days varied from 2.04^{mm} to 2.92^{mm} . In comparing all the absolute heights of the barometer observed at La Guayra at the same hour on different days, differences are remarked that rise to 2.10^{mm} . M. Arago * thinks, from the observations of MM. Boussingault and Rivero, that, at the equator as in the temperate climates,

* *Annales de chimie et de physique*, Tom. xxv, p. 428.

the barometric height of noon may be considered, without sensible errors, as the mean of the day. My observations, made at different heights, north and south of the equator, seem to prove that the mean of noon is generally a little more elevated in Equinoctial America, than the mean of 9^h and 4^h, the barometer descending much less rapidly from 9^h till noon, than from noon till 4^h. I draw this result from 260 observations taken by chance from my registers.

A long series of observations made on a tableland of India, at the foot of the Himalaya, * cannot lead to an analagous result, because the *maximum* of the morning is not indicated; but that series gives with precision the mean of the hours of noon, 3^h in the afternoon, 9^h in the evening, and 4^h in the morning, in hundredths of the English inch.

* Francis Hamilton, formerly Buchanan, Account of the kingdom of Nepaul, 1819, p. 230. In comparing 9^h in the evening and 4^h in the morning, it must not be forgotten that the *maximum* of the evening tide falls between 10^h and 11^h.

OBSERVATIONS AT KATHMANDU, LAT. 27° 41'.

| 1802 and 1803. | MEAN HEIGHTS OF | | | | MEAN TEMPERAT. Thermometer of Fahr. |
|-------------------------|-----------------|------------------------------|-----------------------------------|-----------------------------------|--|
| | noon. | 3 ^h afternoon. | 9 ^h in the evening. | 4 ^h in the morning. | |
| May - - - | 25.46 | 25.40 | 25.41 | 25.43 | 72.8° |
| June - - - | 25.20 | 25.19 | 25.18 | 25.18 | 74.2 |
| July - - - | 25.13 | 25.11 | 25.13 | 25.13 | 75.5 |
| August - - | 24.98 | 24.94 | 24.96 | 24.96 | 72.3 |
| September - | 25.05 | 25.01 | 25.03 | 25.03 | 71.5 |
| October - - | 25.20 | 25.16 | 25.32 | 25.22 | 66.1 |
| November - | 25.31 | 25.24 | 25.28 | 25.34 | 58.7 |
| December - | 25.31 | 25.24 | 25.31 | 25.36 | 51.5 |
| January - - | 25.32 | 25.27 | 25.31 | 25.36 | 48.1 |
| February - - | 25.28 | 25.21 | 25.25 | 25.26 | 51.5 |
| $\frac{1}{2}$ March - - | 25.25 | 25.18 | 25.19 | 25.22 | 56.2 |
| Mean - - - | 25.23 | 25.18 | 25.22 | 25.23 | 63.6 |

As we are ignorant of the mean temperature of the epochas of the day and night when these observations were made, on the table-land of Kathmandu, the mean of the barometric heights from 3^h in the afternoon till 4^h in the morning, cannot be directly compared together; but the observations of M. Dorta * made at Brazil, (the most numerous and complete which have hitherto been published on the horary variations in the southern hemisphere), furnish the possibility of a direct comparison. I have added the mean temperature of the hours expressed in degrees of the thermometer of Fahrenheit. In reducing to the temperature of zero the barometric mean of the following table, we find for 10^h in the morning 28ⁱⁿ 2.01^{li}; for noon 28ⁱⁿ 1.57^{li}; for 4^h in the afternoon 28ⁱⁿ 0.97^{li}; for 10^h evening 28ⁱⁿ 1.81^{li}. The extent of the variations is therefore from 10^h in the morning till 4^h in the afternoon, 2.34^{mm}; that from 4^h in the afternoon till 10^h in the evening 1.89^{mm}. The mean of noon is 0.17^{mm}, more elevated than the mean of day,

* *Mem. de Acad. de Lisboa.*, Tom. ii, p. 397—398. M. Dorta having made observations only every 2 hours, we could not present the barometric heights of 9^h in the morning and 11^h in the evening, which I should have preferred. The heights are expressed in inches and hundredths of lines of the French foot, and are not yet reduced to the temperature of zero.

computed from the *maximum* of the morning, and the *minimum* of the afternoon. The extent of the variations were the same in the hottest months (January and February), and in the coldest (June and July).

MEAN OF THE BAROMETER AND THERMOMETER AT RIO JANEIRO.

| MONTHS OF THE YEAR 1785. | at 10 ^h in the morning | | at noon | | at 4 ^h in the afternoon | | at 10 ^h at night | | Apparent difference of 10 ^h in the morn. and 4 ^h in the aftern. |
|-----------------------------|-----------------------------------|-------|---------|-------|------------------------------------|-------|-----------------------------|-------|--|
| | Bar. | Th. | Bar. | Th. | Bar. | Th. | Bar. | Th. | |
| | in. l. | | in. l. | | in. l. | | in. l. | | l. |
| January | 28 2.22 | 81.1° | 28 1.96 | 81.7° | 28 1.26 | 83.6° | 28 2.30 | 81.7° | 0.96 |
| February | 28 2.12 | 79.4 | 28 1.86 | 80.7 | 28 1.30 | 81.9 | 28 2.15 | 80.5 | 0.82 |
| March | 28 3.18 | 76.1 | 28 2.38 | 76.8 | 28 2.28 | 77.4 | 28 3.00 | 76.3 | 0.90 |
| April | 28 4.00 | 75.5 | 28 3.38 | 75.6 | 28 2.97 | 78.4 | 28 3.89 | 77.7 | 1.03 |
| May | 28 4.74 | 69.9 | 28 4.26 | 71.2 | 28 3.88 | 73.5 | 28 4.60 | 73.4 | 0.86 |
| June | 28 4.77 | 67.3 | 28 4.34 | 68.7 | 28 3.93 | 71.0 | 28 4.55 | 70.0 | 0.84 |
| July | 28 4.65 | 66.7 | 28 4.30 | 68.0 | 28 3.69 | 70.4 | 28 4.40 | 69.6 | 0.96 |
| August | 28 5.06 | 71.1 | 28 4.68 | 72.5 | 28 4.18 | 74.7 | 28 4.73 | 73.7 | 0.88 |
| September | 28 4.22 | 71.6 | 28 3.89 | 73.1 | 28 3.33 | 73.9 | 28 4.13 | 72.4 | 0.89 |
| October | 28 2.56 | 73.6 | 28 2.22 | 75.1 | 28 1.67 | 76.5 | 28 2.50 | 73.7 | 0.89 |
| November | 28 1.68 | 76.2 | 28 1.38 | 77.6 | 28 0.93 | 77.8 | 28 1.73 | 75.4 | 0.75 |
| December | 28 1.38 | 78.3 | 28 1.18 | 79.8 | 28 0.47 | 80.8 | 28 1.44 | 77.8 | 0.91 |
| Mean | 28 3.38 | 72.2 | 28 3.11 | 77.5 | 28 2.48 | 76.6 | 28 3.28 | 75.2 | 0.89 |

The first naturalists* who remarked the great regularity of the ascending and descending movement of the barometer within the tropics, were struck with the inequality which they observed in the extent of the variations between two consecutive days, alike calm and serene. It happens, for instance, that the column of mercury attains a greater height than usual at the hours of the *maximum* of the evening; that it diminishes very little during the night and till 4^h in the morning; that the barometer rises much more from 4^h till 9^h in the morning than it descends from 9^h in the morning till 4^h in the afternoon, and that this play of unequal movements continues during several days. A general tendency is then observed† to the increase or diminution of the column of mercury, without the periodicity or alternancy of the variations being disturbed. They are

* *Literary Journal of the Hague*, 1722, p. 234. Thibault de Chanvalon, *Voyage to Martinique*, p. 135 (23).

† Within the tropics, this tendency modifies the extent of the horary variations, which remains the principal and most sensible phenomenon; in Europe, on the contrary, when the barometer has a general tendency to descend during several days, the lowering is simply slower, or stopped at the epochas of the *maxima*. The principal and most sensible phenomenon is then the tendency of the column of mercury to sink; and the atmospheric tides are manifested only by modifying it a little at the approach of the *limit-hours*.

two kinds of movements, which modify, and add to each other; and it may be said that the barometer remains lower one week than another in the torrid, as in the temperate zone. The knowledge of the limits of the *absolute maxima* and *minima* is very important for the measurement of heights by means of the barometer, whenever between the tropics, without corresponding observations, we deduce from a small number of observations made on a particular spot, and at certain hours of the day, the state of the barometer at every consecutive hour of day and night. Bouguer, La Condamine, and the greater part of the travellers who have spoken after them of horary variations, confound the extent of the oscillations corresponding to one atmospheric tide, with the changes of the mean heights of the barometer in different weeks or different months. Bouguer says * that the column of mercury in the torrid zone varies from $2\frac{1}{2}$ to 3 lines; but that the variations at Quito are only 1 line. The former part of this assertion can relate only to the extreme accidental

* *Figure de la terre*, p. 39. Caldas, in the *Semanario*, Vol. i, p. 248. Don George Juan thought he remarked a diminution in the extent of the oscillations, in proportion as he approached from the tropic to the equator (*Observ. Astronomicas*, p. 99). He fixes this extent at Petit Goave, at $2\frac{1}{2}$ line, and at Guayaquil, at $1\frac{1}{4}$ line.

variations, and not to the extent of the variations during a whole tide. In reviewing the whole of my observations, made at different heights, and in latitudes more or less near the equator, it seemed to me that the extent of the variations diminishes very little with the elevation of the spot, and that it diminishes still less than the barometric mean of different days. At Cumana, La Guayra, Payta, Lima, and Rio Janeiro, at the level of the sea in both hemispheres, the mean extent of the oscillations or atmospheric tides is at most from 2.4^{mm} to 3 millimeters; and the difference of the absolute heights observed at the same hours of different days, amounts to 3, rarely to 4 millimeters*.

* A barometric height at the epocha of the *minimum*, not being compared with a height observed in another week, at the epocha of the *maximum*, the difference of the absolute heights at the same hours in different weeks, may perhaps be less than the extent of the horary oscillations. A traveler who would measure the height of a mountain by means of the barometer, without having corresponding observations on the coast, and who supposed the column of mercury to be invariable at Cumana (neglecting the consideration of the horary oscillations, and that of the difference of the absolute barometric heights, resulting from the accumulation of successive inequalities in the extent of the diurnal oscillations), would deceive himself sometimes in 6 millimeters; for I saw the barometer, July 18th, at 11^h in the morning, at 337.9^{li}, and August 30th, at 4^h in the afternoon, at 335.7^{li}. Colonel Lanz found the barometer at La Guayra, at noon, 26th Fe-

The extent of the horary oscillations at Lima (lat. $12^{\circ} 2'$ south), appeared to us a little less (1.7 to 2.3), than near the equator (2.6 to 3.3), in the forests of Atabapo and of Rio Negro.

bruary, 1822, at 0.76603^m (th. 25° cent.); February 28th, at 0.76510^m (th. 26.5°); March 1st, at 0.76465^m (th. 26.5°); and March 5th, at 0.76325^m (th. 26.6°). If the relative correction of the horary variations be not neglected, there remains only, as a source of error in the measurement of mountains, without a corresponding observation, in the tropics, the difference of absolute barometric heights; and in distinguishing between the difference of extreme dispersion and the oscillations of that dispersion around the mean barometric height, we may conceive that the probable limit of the error arising from the cause we discuss, will rarely be above fifteen or twenty metres. This estimate is important for those who, in the barometric levellings projected for examining provisionally the isthmuses of Huasacualco, Darien, and Panama, may employ only one barometer. In order to know exactly the number of locks which a canal requires, we must, even between the tropics, where every circumstance is so favorable to the use of the barometer for the levelling of the soil, employ two instruments: the one should remain on the seashore, or, which is preferable, should follow the second barometer from station to station, as in the levelling operations executed by MM. de Parrot and Engelhardt, between the North and Caspian Seas. If, on the contrary, we seek only to know approximately (at about twenty metres) the height of the *ridge of partition* which presents a favorable chance for *cutting an isthmus*, one barometer will suffice, which must be observed in going and returning, as ought always to be done in the *chronometric measurement* of distances.

In ascending from the coast of Venezuela on the table-land of Bogota, the difference of the diurnal *maxima* and *minima*, (notwithstanding the difference of 1365 toises of height), diminishes only one-fourteenth, and consequently, not in the relation of the barometric heights of the places we compare. The comparison of the same hours on different successive days furnishes at Santa Fe de Bogota*, and at Popayan (911 t.), scarcely the difference of three or four millimeters in the space of a whole year. The following tables prove, that a great equality in

* See *Semanario de Bogota*, Tom. i, p, 50, 83, 115, 177, 216, 255, 290. I calculated for every day the mean height of the barometer, and by the diurnal oscillations the extended mean of the oscillations in whole months; the results are marked in hundredths of lines of the French foot. M. Caldas announces in an indirect manner (*Semanario*, Tom. i, p. 55), that the *epochas of the limits*, or *tropical hours*, which I published in my *Essay on the Geography of Plants*, are not those which M. Mutis found on the plains of Bogota; this doubt does not appear to me to be well founded. MM. Boussingault and Rivero have confirmed the epocha of the *maxima* and *minima* which I had announced; and even M. Mutis, who is accused of not being very communicative, told me, when I shewed him my registers, "that the periods observed at Cumana were nearly conformable to those resulting from his researches, but that in the hottest days, the *maximum* was attained at Santa Fe de Bogota, at 8^h in the morning." This latter observation recalls the difference of the tropical hours remarked in Europe, by MM. Ramond, Marqué Victor, and Billiet, between the hottest and coldest seasons. (See above, p. 719).

the extent of every tide, produces on the back of the mountains, a surprising uniformity in the mean barometric heights of the months. I shall here present successively the results of the observations made on the same spot (at Santa Fe de Bogota), in 1807 and 1818, by M. Caldas, and in 1823 and 1824, by MM. Boussingault and Rivero. The latter, made with much more exact instruments, merit the highest confidence. M. Caldas finds for the twelve months of the year 1807 :

| | MAXIMA. | MINIMA. | DIFFERENCE. |
|-----------------|---------|---------|-------------|
| January | 247.23 | 247.60 | 1.65 |
| February | 249.33 | 248.33 | 1.00 |
| March | 249.33 | 247.93 | 1.40 |
| April | 249.42 | 247.92 | 1.50 |
| May..... | 249.67 | 248.00 | 1.67 |
| June..... | 249.67 | 248.00 | 1.67 |
| July | 249.50 | 247.83 | 1.67 |
| August..... | 249.42 | 247.92 | 1.50 |
| September | 249.42 | 248.00 | 1.42 |
| October | 249.33 | 247.91 | 1.42 |
| November | 248.92 | 248.00 | 1.92 |
| December | 248.85 | 247.60 | 1.15 |

The mean of 642 barometric heights, observed by the same naturalists, from January to July in the year 1808, presents the following results :

MEAN OF THE HORARY VARIATIONS OF SEVEN MONTHS
ON THE TABLE-LAND OF BOGOTA.

| MONTHS. | BAROMETRIC MEAN OF | | EXTENT OF THE OS- CILLATIONS. | MEAN TEM- PERATURE OF THE MONTHS. |
|--------------|--------------------|---------|-------------------------------------|--|
| | MAXIMA. | MINIMA. | | |
| January ... | 249.04 | 247.99 | 1.05 | 13.2° R. |
| February ... | 248.90 | 247.95 | 0.95 | 14.6 |
| March | 249.02 | 248.03 | 0.99 | 13.7 |
| April | 249.04 | 248.04 | 1.00 | 14.2 |
| May | 249.20 | 248.22 | 0.98 | 13.8 |
| June | 249.17 | 248.28 | 0.89 | 13.8 |
| July | 249.12 | 248.17 | 0.95 | 14.2 |

M. Caldas having published the mean temperature of every day, and the *maxima* and *minima* of the temperature of whole months, but not the temperature from 9^h in the morning till 4^h in the evening, the barometric heights of 1807 could not be reduced to the freezing point. The case is the same with respect to the diurnal observations from January to July 1808. It may, however, be admitted, that the mean temperature of 9^h in the morning (on the table-land of Bogota) is nearly 1.2° lower of the centigrade thermometer, and the mean temperature of 4^h in the afternoon 1.8° higher than the mean temperature of the month.

MEAN HEIGHTS OF THE DAYS, AND EXTENT OF THE DIURNAL OSCILLATIONS ON THE TABLE-LAND OF BOGOTA.

| JANUARY, 1808. | Mean barometric heights. | Extent of the oscillations. | Mean temperature Reaumur. | JANUARY. | Mean barometric heights. | Mean temperature Reaumur. | Extent of the oscillations. | JULY, 1808. | Mean barometric heights. | Extent of the oscillations. | Mean temperature Reaumur. | JULY. | Mean barometric heights. | Extent of the oscillations. | Mean temperature Reaumur. |
|----------------|--------------------------|-----------------------------|---------------------------|----------|--------------------------|---------------------------|-----------------------------|-------------|--------------------------|-----------------------------|---------------------------|-------|--------------------------|-----------------------------|---------------------------|
| 1 | 248.33 | 1.34 | 14.1° | 16 | 248.58 | 1.16° | 12.3 | 1 | 248.62 | 0.75 | 14.5° | 16 | 248.50 | 1.00 | 14.4° |
| 2 | 248.29 | 1.42 | 14.0 | 17 | 248.58 | 0.83 | 12.9 | 2 | 248.50 | 1.00 | 14.6 | 17 | 248.50 | 1.00 | 14.5 |
| 3 | 248.29 | 1.42 | 13.9 | 18 | 248.58 | 0.83 | 13.2 | 3 | 248.75 | 1.00 | 14.1 | 18 | 248.83 | 1.00 | 13.0 |
| 4 | 248.33 | 1.15 | 13.1 | 19 | 248.75 | 1.00 | 11.3 | 4 | 248.45 | 0.75 | 14.5 | 19 | 249.00 | 1.00 | 14.0 |
| 5 | 248.50 | 1.00 | 14.0 | 20 | 248.50 | 1.00 | 12.1 | 5 | 248.45 | 0.91 | 14.5 | 20 | 249.00 | 1.00 | 14.0 |
| 6 | 248.16 | 1.00 | 14.4 | 21 | 248.75 | 1.00 | 12.8 | 6 | 248.58 | 1.00 | 14.3 | 21 | 248.87 | 0.75 | 14.2 |
| 7 | 248.16 | 1.00 | 15.2 | 22 | 248.75 | 1.00 | 12.9 | 7 | 248.83 | 1.00 | 13.8 | 22 | 248.79 | 0.92 | 14.0 |
| 8 | 248.24 | 1.17 | 12.8 | 23 | 248.49 | 0.83 | 13.0 | 8 | 248.75 | 1.00 | 14.0 | 23 | 248.83 | 1.00 | 14.0 |
| 9 | 248.12 | 0.92 | 12.8 | 24 | 248.87 | 1.25 | 12.1 | 9 | 248.37 | 0.75 | 15.0 | 24 | 248.87 | 0.75 | 13.4 |
| 10 | 248.41 | 0.83 | 13.0 | 25 | 249.00 | 1.00 | 13.4 | 10 | 248.37 | 0.75 | 14.6 | 25 | 248.87 | 0.75 | 14.1 |
| 11 | 248.55 | 1.10 | 12.0 | 26 | 248.70 | 1.25 | 15.9 | 11 | 248.83 | 0.67 | 15.0 | 26 | 248.50 | 1.00 | 15.0 |
| 12 | 248.55 | 1.10 | 12.0 | 27 | 247.87 | 1.75 | 13.8 | 12 | 248.62 | 1.09 | 14.5 | 27 | 248.50 | 1.00 | 14.2 |
| 13 | 248.41 | 0.83 | 13.5 | 28 | 248.41 | 0.83 | 13.9 | 13 | 248.37 | 0.75 | 15.5 | 28 | 248.67 | 1.00 | 14.5 |
| 14 | 248.75 | 1.00 | 11.6 | 29 | 248.70 | 0.75 | 13.9 | 14 | 247.91 | 0.83 | 15.0 | 29 | 248.75 | 1.00 | 13.0 |
| 15 | 249.08 | 0.84 | 15.7 | 30 | 248.79 | 0.75 | 13.8 | 15 | 248.50 | 1.00 | 14.3 | 30 | 248.75 | 1.00 | 14.0 |
| | | | | 31 | 248.50 | 1.00 | 11.9 | | | | | 31 | 248.75 | 1.00 | 13.6 |

In examining for seven months the mean barometric height of the days, observed by M. Caldas, I find the least height to be 247.8^{li} ; and the greatest 249.0^{li} . This difference of 1.2^{li} , or 2.7^{m} , is the effect of small inequalities of diurnal oscillations which accumulate by degrees. It was 3.12^{mm} , in the observations of M. Boussingault. Once only the extent of the variations of the day was but 0.63^{mm} ; and once only it rose to 3.64^{mm} . In comparing the observations day by day from 9^{h} in the morning till 4^{h} in the afternoon, I find that in the observations of M. Caldas, the variations at 9^{h} were from 248.30^{li} to 249.50^{li} ; and at 4^{h} from 247.00^{li} to 248.66^{li} ; whence result the differences for 9^{h} , of 2.7^{mm} , and for 4^{h} , 3.6^{mm} . The labors of M. Boussingault give for those two limit-hours, 4.6^{mm} and 4.21^{mm} . The limits of the accidental oscillations round the mean of the same hours, were consequently nearly the same at 1365 toises of height, as at the level of the equinoxial sea; but those extreme limits appear to me to be much more rarely attained on the back of the Cordilleras. The new observations of MM. Rivero and Boussingault, made with excellent barometers of Fortin, furnish the most certain notions hitherto obtained on the laws we have just discussed. They yield, for the mean extent of the oscillations, from 9^{h} in the morning till 4^{h} in the afternoon 2.29^{mm} (reducing the barometric heights to the temperature of zero.)

MAXIMA AND MINIMA OF DAYS OBSERVED ON THE TABLE LAND OF BOGOTA.

| AUG. 1823. | BAROMETER at 9h in the morning. | BAROMETER at 4h in the afternoon. | DIFFERENCE. | AVG. 1823. | BAROMETER at 9h in the morning. | BAROMETER at 4h in the afternoon. | DIFFERENCE. | DEC. 1823. | BAROMETER at 9h in the morning. | BAROMETER at 4h in the afternoon. | DIFFERENCE. |
|------------|---------------------------------------|---|-------------|------------|---------------------------------------|---|-------------|------------|---------------------------------------|---|-------------|
| 1 | 561.18 | 559.46 | 1.72 | 16 | 561.94 | 559.48 | 2.46 | 16 | 561.45 | 558.68 | 2.77 |
| 2 | 562.09 | 559.63 | 1.80 | 17 | 561.88 | 559.65 | 2.23 | 17 | 561.58 | 558.90 | 2.68 |
| 3 | 562.18 | 560.28 | 1.90 | 18 | 562.47 | 559.95 | 2.24 | 18 | 561.88 | 559.03 | 2.85 |
| 4 | 562.00 | 560.03 | 1.97 | 19 | 562.59 | 560.18 | 2.41 | 19 | 561.13 | 559.03 | 2.10 |
| 5 | 562.44 | 560.20 | 2.24 | 20 | 562.63 | 560.03 | 2.60 | 20 | 560.51 | 558.33 | 2.18 |
| 6 | 562.81 | 561.33 | 1.48 | 21 | 562.83 | 560.63 | 2.20 | 21 | 560.70 | 558.73 | 1.97 |
| 7 | 562.95 | 560.73 | 2.20 | 22 | 562.60 | 560.02 | 2.57 | 22 | 561.08 | 558.27 | 2.81 |
| 8 | 562.40 | 559.74 | 2.66 | 23 | 562.11 | 560.02 | 2.09 | 23 | 560.63 | 557.76 | 2.87 |
| 9 | 562.35 | 559.81 | 2.54 | 24 | 561.93 | “ “ | “ “ | 24 | 560.63 | 558.00 | 2.63 |
| 10 | 562.08 | 559.94 | 2.14 | 25 | 561.88 | 560.36 | 1.52 | 25 | 560.80 | 558.95 | 1.85 |
| 11 | 562.23 | 559.90 | 2.33 | 26 | 561.18 | 559.56 | 1.62 | 26 | 560.88 | 558.44 | 2.44 |
| 12 | 561.73 | “ “ | “ “ | 27 | 561.53 | 559.01 | 2.52 | 27 | 561.00 | 558.88 | 2.12 |
| 13 | 561.23 | “ “ | “ “ | 28 | 562.62 | 559.93 | 2.69 | 28 | 560.96 | 558.48 | 2.47 |
| 14 | 562.03 | “ “ | “ “ | 29 | 562.62 | 559.73 | 2.69 | 29 | 561.50 | 559.14 | 2.36 |
| 15 | 562.01 | 559.93 | 2.22 | 30 | 562.13 | 559.54 | 2.49 | 30 | 561.84 | 559.23 | 2.61 |
| | | | | | | | | 31 | 562.38 | 559.90 | 2.48 |

At nine in the morning, on the 8th and 29th, violent hail, with thunder.

The heights of the barometer are in hundredths of millimeter. We shall choose two months only on the whole year, of which we are in possession. M. Boussingault justly observes, that "the mean monthly heights are greatest in June and July; and the least in December and January, when the earth is nearest the sun." The following are the mean heights reduced, as in the table of the month of August and December, to the temperature of zero. I have placed by the barometric mean, the mean extent of the diurnal oscillations from 9^h till 4^h, and the mean of the temperature corresponding to those epochas of the morning and afternoon. M. Ramond, from the year 1814, has thrown great light on the curious phenomenon of the monthly oscillations of the barometer.

MONTHLY MEAN OF THE BAR. AT BOGOTA
(LAT. 4° 35' 50").

MONTHLY MEAN AT STRASBOURG
(LAT. 48° 34' 56").

| RESULTS of a year. | MEAN BAROMETRIC heights. | MEAN of the oscillations. | MEAN TEMPERATURE from 9 ^h till 4 ^h | RESULTS of 14 years. | MEAN BAROMETRIC heights. | EXTREME DIFFERENCE of the max. and min. |
|-----------------------|--------------------------------|---------------------------------|--|-------------------------|--------------------------------|--|
| January | 0.56045 ^m | 2.31 ^m | 15.7° | January | 333.128 ^{li} | 6.136 ^{li} |
| February ... | 0.56048 | 2.31 | 15.9 | February ... | 333.452 | 3.646 |
| March | 0.56061 | 2.39 | 15.3 | March | 332.905 | 4.573 |
| April | 0.56113 | 2.34 | 15.2 | April | 332.449 | 4.127 |
| May | 0.56075 | 2.45 | 15.4 | May | 332.516 | 1.964 |
| June | 0.56124 | 1.86 | 15.1 | June | 333.416 | 2.563 |
| July | 0.56134 | 1.50 | 14.2 | July | 333.168 | 2.385 |
| August | 0.56111 | 2.22 | 16.6 | August | 333.352 | 1.201 |
| September ... | 0.56094 | 2.59 | 16.2 | September ... | 333.633 | 2.471 |
| October | 0.56071 | 2.77 | 15.3 | October ... | 332.981 | 4.163 |
| November ... | 0.56045 | 2.44 | 15.1 | November ... | 332.866 | 5.376 |
| December ... | 0.56013 | 2.40 | 15.0 | December ... | 332.700 | 3.881 |

The movement of the barometer at Bogota is of surprising regularity; the mean heights acquire their *minimum* at the winter solstice, augment till after the summer solstice, and again decrease, without presenting any other anomaly than that of the month of May. This new and curious remark, is owing to the observations of MM. Boussingault and Rivero, and which those able naturalists found confirmed by the observations of M. Caldas, made in 1807. In our temperate climates, at Strasbourg for instance, the observations of M. Herrensneider, during fourteen years, (indicated in lines of the French foot, and reduced to 15° centigrade temperature,) prove that the monthly mean * is highest in September, and lowest in April; in general however, the mean heights from June to September exceed those from October to February. The extent of the extreme variations in Europe presents great regularity; it decreases from winter to summer.

In the town of Mexico †, although near the tropic, I have hitherto found the extent of the ho-

* Seven years have proved to M. Ramond (*Mem. de l'Inst.*, 1812, Tom. ii, p. 44) that the mercury is highest at Clermont, in January and June, and lowest in April and November.

† This phenomenon, which is very common at Vera-Cruz in the season of *Nortes*, was observed at Mexico (at 1168 t. high) once only in a great number of years. (*Antonio Gama*,

rary oscillations extremely uniform. At the same hours the barometric heights scarcely differ from 2 to $2\frac{1}{2}$ millimeters during whole months. But sometimes the north winds, which are so impetuous in the gulph of Mexico, blow back the air as far as the table land of Anahuac, and suddenly raise the mercury. This blowing back caused the barometer to mount * on the 23rd March, 1783, at 10^h at night, 264 lines, while the *minimum* of all the heights observed in the whole year (20th January, 1783) was 259.3^{li}. In deducting the effect of the periodical oscillations, the extreme variations attain at the same hour of the *maxima* and the *minima*, by a concurrence of accidental circumstances, at most 3.8^{li} or $8\frac{1}{2}$ millimeters. We are surprised to see this constancy in the extent of the oscillations on a table land, where, in 19° 25' of latitude, the thermometer descends in winter, between 4^h and 5^h in the morning, several

Dissertacion fisica sobre la aurora boreal del 14 Nov. 1789, p. 14). I saw the barometer of Mexico descend at the epocha of the *minimum*, to 258.2^{li} (therm. 22° cent.) I saw it highest at the hour of the *maximum*, 260^{li}. (therm. 18.8°).

* *Political Essay*, Vol. i, p. 83. During this blowing back of the air, which is borne towards the boreal regions of the south, the centigrade thermometer does not sink at Vera-Cruz (in the lower layers of the atmosphere) lower than from 20° to 18°, and at most to 16.5°.

degrees below zero. The north winds on the eastern coast of Mexico, at Vera-Cruz, (lat. $19^{\circ} 11'$) often interrupt suddenly the regularity of the horary variations, during 5, 6, and even 8 days, and make the mercury oscillate from 333 to 341 lines, (difference 18 millimeters). I have stated in another place the importance of which this phenomenon, studied by M. Orta, captain of the port of Vera-Cruz, in all its various modifications, is become for the safety of navigators who would sail in these dangerous latitudes. By inspecting the barometer, the proximity of the tempest, its force and duration may be prognosticated with great probability. I saw in the possession of M. Orta, near 28,000 thermometric and barometric observations, made with excellent instruments of Dollond, at the port of Vera-Cruz, from 1791, to 1803, four times a day, at 6^h in the morning, at noon, 4^h in the afternoon, and 10^h in the evening. I advised that indefatigable observer to send a mass of materials so valuable, (the most considerable perhaps that was ever collected within the tropics, on the same spot), to Europe, to be deposited in the archives of some learned society. It is to be feared that the calamities which the town of Vera-Cruz has recently suffered during the bombardment of the Castle of San Juan d'Uloa, may have deprived the scientific world of the labours of M. Orta.

We see that in advancing in the plains and on the back of the Cordilleras, from the equator towards the tropics, the proximity of the temperate zone renders the barometric mean of the months more and more unequal, because the accidental causes begin to act with greater force. At the extremity of the northern torrid zone, at the Havannah (lat. $23^{\circ} 8'$), the mean barometric height of the months differs with respect to their general equality, very little from the mean height of the months at Rio Janeiro (lat. $22^{\circ} 54'$), which is situated near the extremity of the southern torrid zone. It is interesting to compare, from the excellent observations of MM. Dorta, Robredo *, and Ferrer †, the variations of the weight of the atmosphere in the vicinity of the two tropics. At Rio Janeiro ‡ the extreme barometric mean of December and August; and at the Havannah, that of September and January, differ nearly 8 millimeters, while at Bogota, nearer the equator, the monthly mean does not swerve $1\frac{1}{2}$ millimeters.

* *Observ. meteorologicas hechas en la Havana y en el pueblo de Ubajay* (manuscript).

† *Conn. des temps pour 1817*, p. 338.

‡ Rio Janeiro : mean height, bar. in December 1785, 337.02^{li} (th. 25.7° cent.); in August, 340.59^{li} (th. 22.1°); at the Havannah (1810—1812), in September, 761.23^{mm} (th. 28.8° cent.); in January, 768.09^{mm} (th. 21.1°). Reduced to the temperature of zero, the difference near the tropic of capricorn is, 8.3^{mm} : near the tropic of cancer, 7.9^{mm} .

HAVANNAH.—*Mean of the months during the years, 1810-1812.*

| | Barometer. | Centigrade Thermometer. |
|-----------------------|----------------------------|----------------------------|
| January | 0.76809 ^m | 21.1° |
| February | 0.76301 | 22.2 |
| March | 0.76428 | 24.3 |
| April | 0.76301 | 26.1 |
| May..... | 0.76199 ... | 28.1 |
| June..... | 0.76453 | 28.4 |
| July .. | 0.76453 | 28.5 |
| August..... | 0.76123 | 28.8 |
| September | 0.76098 | 27.8 |
| October | 0.76174 | 26.4 |
| November | 0.76453 | 24.2 |
| December | 0.76656 | 22.1 |
| Mean of the year..... | 0.76371 | 25.7 |

The least height of the barometer, during those three years, was at 25° of temperature, and in a furious wind from S.S.W. on the 25th October, 1810, it was 0.74472^m; the greatest height was observed on the 20th of February, 1811, and was 0.77545^m: the difference of those two numbers (0.03073^m), is the greatest barometric variation ever observed in that island. During the stay I twice made at the Havannah, my barometer rose (the temperature being the same), during the strong gales from N.N.E. 4 lines (9 millimeters) more than in

the tempestuous winds from the south *. The meteorologic journal of M. Robredo proves that these differences are alike remarked far from the coast, in the interior of the island. It is not the mean of the months that differs more near the tropic of cancer than near the tropic of capricorn, it is rather the extreme heights owing to accidental causes. At the boundary of the southern torrid zone, the extreme oscillations † of the barometer attain only 21 millimeters (9.3^{li}) ; at the extremity of the northern torrid zone, they are often 25 millimeters, sometimes 30.5^{mm} (13.3^{li}). The southern hemisphere, south of the parallel of 23° , contains a very small portion of land ; and the atmosphere

* The hurricanes are not in general accompanied by such an extraordinary lowering of the barometer as is imagined in Europe. I possess 56 barometric observations made by the captain of a ship, Don Tomas de Ugarte, nearly from hour to hour, at the Havannah, during the terrible hurricane of the 27th and 28th of August, 1794. When the tempest was most violent, the column of mercury sunk only 5 lines (11.3^{mm}). Kirwan asserts however, that at the island of Saint Bartholomew, the barometer has been seen to lower in a hurricane (1792), 42 millimeters. *Irish Trans.*, vol. viii, p. 387. Is this fact as well certified as a lowering of 25 millimeters at the Isle of France ? (*Moreau de Jonnès, Hist. phys. des Ant.*, Tom. i. p. 420). See on the barometric heights observed on the coast of Chili, *Espinosa, Memorias de los Naveg. Esp.*, Tom i, p. 129, 134, 179.

† In December and March. See *Mem. de Lisboa*, Tom. ii. p. 397.

for that reason, is less violently agitated than in the northern hemisphere.

Almost on the parallel of the Havannah, but 164° more to the west, at Canton and Macao in China, the extent of the horary oscillations presents nearly the same constant equality: the mean of the months differ* $7\frac{1}{2}$ millimeters; but the greatest variation observed during a whole year on the same day, (January 15th 1814), was only 4 millimeters.

At Cairo, where (as in the Canary Islands), the mean horary variations do not rise above 0.5^{li} or 0.8^{li} (1.10^{mm} or 1.76^{mm}), the extreme variations are inconsiderable, and scarcely differ from those which M. Dorta observed at Rio Janeiro. M. Coutelle† saw the column of mercury vary only 22 millimeters in the course of three years, from the effect of accidental perturbations. These limits of perturbation approach

* I find from the manuscript journal of the M. l'abbé Richenet, the mean of the twelve months of the year 1814, at Macao, as follows: 30.34^{in} (th. 68° Fahr.); 30.30 (th. 65°); 30.26 (th. 66°); 30.11 (th. 71°); 30.11 (th. 74°); 29.96 (th. 81°); 29.99 (th. 83°); 29.99 (th. 83°); 30.15 (th. 80°); 30.19 (th. 78°); 30.28 (th. 72°); 30.35 (th. 62°). Mean of the year 30.17^{in} (th. 74°). The scale is in English inches. The barometric heights are not reduced to the temperature of zero.

† At Cairo, January 3rd 342.0^{li} (th. 5.5° R.); January 16th, 335.5^{li} (th. 10). Difference reduced to the temperature of zero, 15.41^{mm} .

nearer than at the Havannah, in the system of American climates.

The diminution in the extent of the horary variations, in advancing from the equator * towards the pole, was remarked by M. Ramond† as soon as he began to compare the results of his observations at Clermon-Ferrand with those which I had collected in the torrid zone. "The extent of the variations," says this able naturalist, "is half less in France than between the tropics. The *maximum* of the variations in our climates is in spring: the ascent of the day in Europe is nearly equal to the preceding lowering, while in the tropics

* At Senegal (lat. $15^{\circ} 53'$) a well-informed traveller M. de Beaufort, found recently, by means of observations that comprehend two months and a half, the extent of the horary oscillations to be 2.7^{mm} . He gives for 7^{h} in the morning 0.7629^{m} (th. 21°); for noon 0.7654 (th. 25°); for 4^{h} in the afternoon, 0.7663^{m} (th. 23°); and for 8^{h} in the evening, 0.7667^{m} (th. 19°). Reduced to the temperature of zero, the observations of noon, and at 4^{h} in the afternoon give, 0.7619^{m} , and 0.7631^{m} , and not, as is asserted in a letter addressed to M. Jomard (January 25th 1824), 0.7631^{m} , and 0.7658^{m} . (*Bulletin de la Soc. de Géographie*, p. 14, 59). *Hertha*, 1825, n. 3, p. 143. These observations little accord with what has been found in every other part of the earth, where the barometer has every where been seen lower at 4^{h} in the afternoon, than at 8^{h} in the morning, and at noon.

† *Mém. de l'Institut*, 1808, p. 107, and 1812, p. 46.

these quantities differ from single * to double." M. Arago, whose meteorological observations already comprehend 9 years, and who disposed them in such a manner as to place most in evidence the value of the diurnal variation † of the barometer, finds, that the descending oscillation at Paris, from 9^h in the morning till 3^h in the afternoon, is only 0.8^{mm} (0.35^{li}); and that in reducing all the heights to the same temperature, the mean of 15 to 20 days suffices, at all seasons, to ascertain the existence and movement of the horary oscillations ‡. We have seen that the mean of the barometric

* According to my first view, the type of the movement of the barometer, on the shore of the equinoctial sea, appeared to me as follows: the mean barometric height at 8^h in the morning, will give, $h + 0.5^{li}$; at 4^h in the afternoon, $h - 0.4^{li}$; at 11^h at night, $h + 0.1^{li}$; at 4^h in the morning, $h - 0.2^{li}$. It results from this hypothesis, for 9^h in the morning, 338.30^{li}; for noon, 338.02^{li}; for 4^h in the afternoon, 337.40^{li}; for 11^h at night, 337.91^{li}; for 4^h in the morning 337.60^{li}. See my *Essay on the Geogr. of Plants*, p. 91, and my *Rec. d'Obs. astr.*, vol. i, p. 286, 289.

† See the important discussions in the *Annales de chimie et de physique*, Vol. iii, p. 442; Vol. vi, p. 439; Vol. ix, p. 426; Vol. xii, p. 421; Vol. xv, p. 416; Vol. xviii, p. 407.

‡ It is to be regretted that the observations at Paris and Geneva cannot be compared, the latter containing no element that serves to make known the horary observations. (*L. c.*, Vol. vi, p. 440).

heights of the months, differs 1.2^{mm} , near the equator, and 8^{mm} , near the tropics of cancer and capricorn (at Rio Janeiro and the Havannah). At Paris (lat. $48^{\circ} 50'$) the monthly mean generally varies from 8 to 9 millimeters* in one year. The compensation of these accidental variations is such, that at the center of temperate Europe, one month suffices to approach at least $\frac{1}{8}$ nearer the mean value of the barometric heights, than that which we find on the confines of the equinoctial and temperate zone †.

M. Marqué Victor found at Toulouse (lat. $43^{\circ} 35'$) the mean of the extent of the horary oscillations, 1.2^{mm} ; he remarked no connection

* I wish I could compare Paris with some spot placed in the same latitude, on the eastern coast of America; but we have hitherto no precise observations on the horary variations of the barometer, except those which an observer full of zeal, M. Jules Wallenstein, has lately made at Washington (lat $38^{\circ} 55'$), where the mean temperature (14.7° cent.) is 4 degrees above the mean temperature of Paris. The barometric heights of the different months varied at Washington in 1824, 14.8^{mm} , or $6\frac{1}{2}$ lines; which proves how much the atmosphere is subject to great variations, on the eastern coast of the United States. (*Amer. Trans.*, 1824, p. 7).

† In some years it has happened that the barometric mean of the months has differed less at Paris than at Rio Janeiro, and the Havannah. This difference was only from $5\frac{1}{2}$ to $6\frac{1}{2}$ millimeters, in 1816 and 1819.

between the greatness of the horary oscillations, and the seasons *; but this connection is manifest at Paris by the mean of 72 months. The extent of the oscillations from 9^h in the morning till 3^h in the afternoon, was found, in the months of November, December, and January, to be only 0.54^{mm}; and in the three following months, † 1.05^{mm}. The same difference is manifested in the observations made by M. Ramond, at Clermont-Ferrand. M. Billiet found in 1822 and 1823, the extent of the horary variations at Chambéry (lat. 45° 34') to be in winter, 0.90^{mm} and 0.82^{mm}; and at the same epocha, at Paris, 0.69^{mm} and 0.73^{mm}. On the contrary, in the summer months of 1822, and 1823, these quantities attained at Chambéry, 1.29^{mm} and 1.00^{mm}; and at Paris, 0.90^{mm} and 0.75^{mm}. The two whole years which we take for an example, give ‡ for Chambéry, 1.06^{mm};

* *Bibl. univ.*, Tom. xx, p. 246.

† *Laplace, Essai phil. sur les probabilités*, 1825, p. 122.

‡ These differences, which we find in reducing all the observations of Paris, Chambéry, and Toulouse, to the temperature of zero, are so much the more remarkable as the latitude differs only 5°, and the accidental variations observed at the same hours at Chambéry, are $\frac{1}{4}$ less than at Paris. M. Marcel de Serres asserts that he found for one year only (1819), reducing the heights to the temperature of zero, the extent of the oscillations at Montpellier, 1.67^{mm}. M. Arago obtained in the same year, 0.33^{mm}, for Paris. *Bullet. de la Soc. d'Agr. du Hérault. Sept. 1824.*

for Paris, scarcely 0.78^{mm} ; for la Chapelle *, near Dieppe, 0.36^{mm} . I know of no precise or numerous observations for the latitude of 60° ; but M. Bessel has published a very important result which corresponds to the parallel of Königsberg (lat $54^{\circ} 42'$), where the mean of eight years of observations made by M. Sommer with the same instrument, and reduced to the temperature of 10° cent. gives, for 8^{h} and 9^{h} in the morning, 337.351^{li} ; for 2^{h} and 3^{h} in the afternoon, 337.264^{li} ; and for 9^{h} and 10^{h} in the evening, 337.351^{li} . The extent of the horary oscillations is therefore at that high latitude, only 0.087^{li} (scarcely the one-tenth of a millimeter), or 4 times less than at Paris. M. Bessel adds, that those observations at Königsberg are so precise, that, notwithstanding the smallness of the oscillations, the value of the horary variation is ascertained in the mean of each year †.

The mean height of the hour of noon at Paris, scarcely differs in a whole year, according to the remark of M. Arago ‡ one-tenth

* Mean of four years (from 1819 to 1822). The smallness of the oscillations perhaps depends, according to M. Arago, on the elevation of the spot, which is not a tableland. M. Nell de Bréauté, in the *Bibl. univ.*, Tom. xxii, p. 105.

† Schumacher, *Astron. Nachrichten*, 1823, p. 26.

‡ *Annales de Chimie*, Tom. ix, p. 428. M. Billiet finds that at no season, at Chambéry, the mean of noon differs $\frac{1}{2}$

of a millimeter from the mean height determined by the observations of 9^h in the morning, and 3^h in the afternoon. M. Herrensneider observes that in 16 years (1807-1822), the barometric mean of noon differed only 1.8^{mm}; and the general barometric mean of Strasbourg only one-fortieth of a millimeter. The following table presents the results of nine years made at the royal observatory of Paris :

| YEARS. | MEAN | | |
|------------------|-----------------------------------|----------|-------------------------------------|
| | of 9 ^h in the morning. | of noon. | of 3 ^h in the afternoon. |
| 1816 | 754.13 | 753.94 | 753.45 |
| 1817 | 756.48 | 756.16 | 755.69 |
| 1818 | 756.11 | 755.81 | 755.22 |
| 1819 | 755.07 | 754.85 | 754.35 |
| 1820 | 756.10 | 755.85 | 755.37 |
| 1821 | 756.04 | 755.83 | 755.36 |
| 1822 | 757.48 | 757.17 | 756.65 |
| 1823 | 755.04 | 754.78 | 754.29 |
| 1824 | 755.78 | 755.54 | 755.05 |
| Mean of 9 years. | 755.80 | 755.54 | 755.08 |

of a millimeter from the mean of the month. (*Bibl. univ.*, Feb. 1824, p. 93). See an excellent memoir on the horary variations observed at Strasbourg by M. Herrensneider, among those of the *Society of Sciences at Strasbourg*, vol. ii, p. 403.

I have added in the preceding pages a great number of unpublished materials to those dispersed in different works. I shall conclude this task by indicating the laws, or rather the most general relations, which the singular phenomenon of the small atmospheric tides presents :

1° The horary oscillations of the barometer are felt in every part of the earth, in the torrid, as well as in the temperate and frigid zones, at the level of the sea as well as at elevations exceeding 2000 toises. These oscillations are periodical, and every where composed of two ascending and descending movements. The two atmospheric tides are not in general of equal duration *. In comparing results of unequal exactness, and obtained by thirty observers, between 25° of south latitude and 55° of north, we find differences of 2 hours for the epochas of the *maxima* and the *minima*: in excluding five results only, the *maximum* of the morning falls between 8½^h and 10½^h; the *minimum* afternoon, between 3^h and 5^h; the *maximum* of the evening between 9^h and 11^h, and the *minimum* between 3^h and 5^h in the morning. It is to be presumed that those limits will be found to be drawn much nearer when a

* See the *Table of the general statement of the horary observations*. The result most generally is, for the duration of the ascending and descending tides, between the tropics, 6½^h, 6^h, 6^h, and 5½^h.

greater number of observations of equal precision are made for the different zones. Provisionally, we may adopt as the type most generally recognized of *maxima* and *minima*; in the equatorial zone: $+ 21\frac{1}{4}^h$; $- 16^h$; $+ 10\frac{1}{2}^h$; $- 16^h$. In the temperate zone: $+ 20\frac{1}{2}^h$; $- 3\frac{1}{2}^h$; $+ 9\frac{1}{2}^h$; $- 14^h$, astronomical time, reckoned from noon.

2°. In the temperate zone the epochas of the *maximum* in the morning and the *minimum* of the evening, are one or two hours nearer the passage of the sun over the meridian in winter than in summer; but the type of summer is that which most resembles the type observed between the tropics. Observations are wanting above all, for the *minimum* which takes place after midnight; it were to be wished that the influence of the variable epocha of sunrise, on the hour of the morning *minimum*, could be examined.

3°. In the torrid zone, the limit-hours (that is, the instants when the oscillations attain the *maximum* and the *minimum*), are the same at the level of the sea, and on table-lands at the elevation of from 1300 to 1400 toises. It is asserted that this isochronism is not manifested in some parts of the temperate zone, and that at the convent of the Great Saint Bernard, for instance, the barometer lowers at the same hours when it rises at Geneva. If this pheno-

menon be general * in Europe, it remains to be

* Some observations made in Europe in the hollows and on the declivity of mountains, and the supposition of the displacing of the air in the layers superposed on each other, have led some naturalists to believe that the *maxima* and the *minima* could not coincide at la Guayra and Caraccas; on the coast of the South Sea (for instance at Payta), and at Popayan, or Santa Fe de Bogota; at Vera Cruz and at Mexico; on the coast of Malabar, where M. Horsburgh observed, and on the plains of the Mysore and of Nepaul. The preceding tables prove that these doubts are altogether unfounded with regard to the table-lands situated between the tropics. The observations of M. Ramond, made at the height of 210 toises, at Clermont-Ferrand, give us a right to suppose from analogy, that in the elevated plains of La Mancha, in Spain, at 320 toises, we should see the barometer ascend at the same hours as at Valencia or Cadiz. We have already mentioned, that the observations at Saint Bernard and Geneva, were made at two periods of the day the least fitted to shew us the oscillations of the mercury, at the variable hour of sun-rise, and the fixed hour of two in the afternoon. These periods precede unequally the *maxima* and the *minima*. In the observations at Geneva the barometer is at sunrise, in winter as in summer, a little higher than at two in the afternoon; but at Saint Bernard, during the twelve months of the year 1824, the mean of sunrise was five times lower (January, April, June, August, October,) three times higher (February, May, July), and four times equal to the mean of two in the afternoon. (*Bouguer, Fig. de la Terre*, p. 39. *Deluc. Rech. sur les Modif. de l'Atm.*, § 528, 530, and 596. *Bibl. Univ. pour 1820. Juillet*, p. 190, Tom. x, p. 20. *Daubuisson, dans le Journ. de Phys.*, Tom. lxxi, p. 24). In the rapid lowering of the barometer on the 22d of February, 1823, the *maximum* of the descent took

ascertained if it be produced on extended table-lands, as well as in *necks* or narrow passages.

4°. We see every where (as may be supposed) that the variations slacken near the concave and convex summits of the curve they represent; that is, when the barometric heights attain alternatively their *maximum* and their *minimum*; and in some parts of the earth the

place at the same hour at Saint Bernard and Geneva. (*Bibl. Univ.*, Tom. xxii, p. 111). These uncertainties on the isochronism of the oscillations can never be removed, till we possess the mean observations made at the *limit-hours*, for Geneva and Saint Bernard, Milan and the village of Simplon, and for Trento and Inspruck. It may also happen that the *necks* of land situated on the top of the Alps, and surrounded with lofty summits, retard and modify the periods of the *maxima* and the *minima*, and that this local influence ceases in table-lands of greater extent. In order to know if a want of isochronism is manifest in the torrid zone, in certain circumstances, I have recently engaged MM. Boussingault and Rivero to observe their barometers simultaneously at Santa Fe de Bogota, and at la Chapelle de Notre Dame de Guadaloupe, which seems as if it were fixed to a rock almost perpendicularly above the town, with a difference of height of 322 toises. Mr. Daniel (*Meteor. Essays*, 1823, p. 260), thought he recognized in the observations made during the last voyages to the polar regions, especially in Melville Island, and at the Rocky Mountains, that the barometer rises in 74° of latitude, when it falls in 41°. That learned naturalist appears to attribute this phenomenon to atmospheric currents, of which it is not easy to verify the existence.

mercury appears to remain stationary during a very considerable time. That time varies from 15' to 2^h; and in determining with precision the *half-duration* of the stationary state, we should distinguish between the real instant of the *maximum*, and the epocha when the barometer ceases, as to our senses, to rise or fall.

5°. In the torrid zone in general, between the equator and the parallel of 15° north and south, the strongest winds, storms, earthquakes, the most sudden variations of temperature and humidity, neither interrupt nor modify the periodicity of the variations. This is the more worthy of attention, as in some parts of equatorial Asia, where the *monsoons* blow with violence, (for instance in India,) the rainy season entirely masks the type of the horary variations, and that at the same period when these variations are insensible in the interior of the continent, on the coast, and in the straits, they are manifested without any alteration within the same parallel, in the open sea.

6°. Between the tropics, one day and one night suffice to know the *limit-hours*, and the duration of the small atmospheric tides; in the temperate zone, in 44° and 48° of latitude, the phenomena of *periodicity* are manifested at all seasons with great clearness, in the mean of from fifteen to twenty days.

7°. The unequal extent of the diurnal varia-

tions in the torrid zone, produces, at the same hours of different months, more or less considerable differences of barometric height. The extent of the oscillations decreases in proportion as the latitude, and the annual variations, owing to accidental perturbations, augment. The mercury is generally a little less elevated in the *maxima* of the evening than in the *maxima* of the morning. If we confine ourselves to precise observations, sufficiently numerous to yield a mean worthy of belief, we find that the extent of the oscillations in the torrid zone, between the equator and the parallel of 10° , in the tide of from 9^h in the morning till 4^h in the afternoon, is, in the plains, 2.6^{mm} to 3.3^{mm} (p. 735); on the table-land of Bogota (1365 t.), 2.3^{mm} (p. 743); towards the extremity of the southern torrid zone, in the plains, two millimeters (p. 729). The diurnal oscillations vary in the whole year (at Bogota) from 0.63^{mm} to 3.64^{mm}; the mean of the monthly oscillations varies from 1.5^{mm} to 2.7^{mm} (p. 739-742). The extent of the oscillations in the morning tides (from 9^h till 4^h), and in the evening (from 4^h till 11^h), are generally in the tropics, in the relation of 5 : 4, or 5 : 3. The mean barometric heights of the day vary between 0° and 10° of latitude, in the plains, from 3.8^{mm}; and on the table-land of Bogota, three millimeters. A difference of 1400 toises of elevation influences, consequently,

but little the mean of the diurnal oscillations, and the extremes of those oscillations. The mean of the hour of noon between the tropics, is constantly (some tenths of millimeter) more elevated than the general mean of the day, taken from the *maximum* of 9^h in the morning, and the *minimum* of 4^h in the afternoon. In advancing from the equator towards the polar regions, we find the differences of the barometric heights from 9^h in the morning till 4^h in the afternoon; 0°-20° lat. 2.5^{mm} to 3.0^{mm}; 28°-30° lat. 1.5^{mm}; 43°-45° lat. 1.0^{mm}; 48°-49° lat. 0.8^{mm}; 55° lat. 0.2^{mm}.

8°. The monthly barometric means differ from each other, in the tropics, from 1.2^{mm} to 1.5^{mm}; and at the Havannah, Macao, and Rio Janeiro, near the tropics of cancer and capricorn, from seven to eight millimeters, nearly as in the temperate zone. The extreme variations of the year are at the same hours, near the equator, from four to four and a half millimeters; they sometimes rise to 21^{mm}, at the extremity of the equinoxial zone, near the tropic of capricorn, and to twenty-five and thirty millimeters near the tropic of cancer. The limits of the extreme monthly oscillations in the temperate climate of Europe, are in the ascending movement, half as near again to each other, as within the tropic of cancer: this difference between the two zones is much less sensible in the

limits of the descending oscillations. The interruption of the horary oscillations near the tropic of cancer (in the gulph of Mexico) is a prognostic of the proximity of tempests, of their force and duration. The monthly means of the barometric heights diminish regularly from July to December and January, on the table-land of Bogota (p. 739), and even in the southern hemisphere, on the coast of Rio Janeiro (p. 731). The blowing-back of the north winds at the extremity of the northern equinoxial zone, raises the mean of December and January, above that of July and August (p. 726 and 748.

9°. Within the tropics, as well as in the temperate zone, in comparing the extreme swerving of the barometer from month to month, we find the limits of the ascending oscillations two or three times nearer than the limits of the descending oscillations *.

10°. The observations hitherto collected have not indicated a sensible influence of the moon†

* According to the meteorological journal (manuscript) of M. Don Antonio Robredo, at the Havannah, the extreme oscillations in 1801, were, in the *maxima* of the months 30.16ⁱⁿ (angl. measure), and 30.41ⁱⁿ; in the *minima*, 29.52 and 30.38. Difference of the *maxima*, 5.28^{mm}: of the *minima*, 18.20^{mm}. At Paris and Strasbourg the extreme ascending oscillations do not vary more in different months, than from 10 to 12 millimeters; the extreme descending oscillations vary from 20 to 30 millimeters.

† Laplace, *Essai Phil. sur les probabilités*, 1825, p. 119,

on the oscillations of the atmosphere. Those oscillations appear to be owing to the sun,

123, 274 ; *Conn. des temps pour 1825*, p. 312. The influence of the lunar attraction would be more easily ascertained between the tropics, when the accidental perturbations mask so little the play of the horary variations. I watched several nights, without observing any thing satisfactory on this subject ; but M. Mutis assures me he discovered that “ at Santa Fe de Bogota the barometer mounts and descends most in the quadratures, while at the epocha of the oppositions and conjunctions, the difference of 11^h at night and $3\frac{1}{2}^h$ in the morning becomes extremely small.” M. Caldas (*Semanario*, Vol. i, p. 55) mentions also this observation of his master. It were to be wished that the meteorological journals which M. Mutis kept during thirty to forty years, were carefully examined, if several of those precious manuscripts were not dispersed after his death, during the political troubles of New Grenada. M. Boussingault, who devotes himself with the same ardour to the examination of every physical phenomenon, has again gone over the labours of M. Mutis (employing much more perfect instruments) in the syzygies as well as the quadratures, at the hours of the passage of the moon over the meridian, but he could not ascertain the lunar influence on the barometric heights. He writes to me from Santa Fe de Bogota, (February 9th, 1825), “ I dare not altogether deny,” he writes, “ the lunar influence on the mean height of the mercury, but I believe that if that influence exists, it is scarcely sensible, because it is lost among the other causes of the horary variations.” Seeking to collect in this work whatever can throw light on the *Meteorology of the torrid zone*, I believe it will be agreeable to naturalists to find at the end of this memoir, a part of M. Boussingault’s observations on lunar influence. It will be seen that the mean of the syzygies differs only 0.16^{mm}

which acts, not by its mass (by attraction), but as a *calorifying* orb. If the solar rays, in modifying the temperature, produce periodical changes in the atmosphere, it remains to be explained why the two barometric *minima* nearly coincide with the hottest and coldest periods of the day and night.

from the mean of the quadratures. Toaldo thought he had found by the mean of 40 years, and by employing a method little exact, that the barometer in Italy is higher in the quadratures than in the syzygies, in the apogee than in the perigee. (*De la Inst. degli astri*, 1781, p. 122. *Lambert, Act. Helv.*, Tom. iv, p. 123. *Journ. de Phys.*, 1799, June, p. 270.)

BAROMETRIC MAXIMA OF NINE IN THE MORNING (REDUCED TO THE TEMPERATURE OF ZERO) OBSERVED AT SANTA FE DE BOGOTA, BY MM. BOUSSINGAULT AND RIVERO, TO EXAMINE THE INFLUENCE OF THE SYZYGIES AND QUADRATURES ON THE HORARY VARIATIONS.

| DAYS OF THE LUNAR PHASES. | NEW MOON. | FIRST QUARTER. | FULL MOON. | SECOND QUARTER. |
|--------------------------------|----------------------|----------------------|----------------------|----------------------|
| August 6, 13, 21, 29, 1823 | 0.56244 ^m | 0.56173 ^m | 0.36283 ^m | 0.56262 ^m |
| September 4, 12, 20, 27 | 0.56237 | 0.56187 | 0.56283 | 0.56294 |
| October 4, 12, 19, 26 | 0.56221 | 0.56218 | 0.56108 | 0.56258 |
| November 2, 10, 18, 25 | 0.56183 | 0.56148 | 0.56230 | 0.56215 |
| December 2, 10, 17, 24 | 0.36233 | 0.56100 | 0.56158 | 0.56063 |
| January 1, 9, 16, 23, 1824 | 0.56205 | 0.56063 | 0.56171 | 0.56263 |
| January 31, February 8, 14, 21 | 0.56192 | 9.56151 | 0.56082 | 0.56168 |
| February 29, March 8, 15 | 0.56248 | 0.56198 | 0.56228 | • • • • • |
| March 30, April 13, 21 | 0.56164 | • • • • • | 0.56202 | 0.56312 |
| April 29, May 6, 13, 20 | 0.56251 | 0.56263 | 0.56196 | 0.56241 |
| May 28, June 4, 11, 19 | 0.56150 | 0.56168 | 9.56201 | 0.56163 |
| June 26, July 3, 11, 19 | 0.56259 | 0.56103 | 0.56233 | 0.56198 |
| Mean | 0.56216 | 0.56161 | 0.56198 | 0.56222 |

The first column indicates the days when the observations of 9^h were nearest the epocha of the syzygies, and quadratures. In the temperate zone a decade often suffices to ascertain the periodicity of the atmospheric tides; but the preceding table renders it probable that within the tropics, twelve days of observations, the days of sizygies and quadratures, are not sufficient to disengage the lunar effect from accidental perturbations. More positive results would be obtained, if, after having collected a great number of observations made at the instant of the passage of the sun and moon over the meridian, the regular effects of the diurnal period were defalcated.

OBSERVATIONS OF HORARY VARIATIONS (NOT REDUCED TO THE SAME TEMPERATURE) MADE BY M. BOUSSINGAULT AT SANTA FE DE BOGOTA, IN 1824, TO EXAMINE THE INFLUENCE OF THE PASSAGE OF THE MOON OVER THE MERIDIAN ON THE OSCILLATIONS OF THE BAROMETER.

| | | | |
|-----------|-------------------------------|----------------------|---------------------|
| January 3 | 9 ^h | 0.56300 ^m | Temp. of B. 14.5°C. |
| | 10 | 0.56265 | 16.5 |
| | 11 | 0.56225 | 16.3 |
| | noon | 0.56180 | 16.5 |
| | 1 | 0.56095 | 16.5 |
| | 2 | 0.56005 | 16.5 |
| | 3 | 0.55957 | 16.3 |
| | 4 | 0.55955 | 16.2 |
| | 11 | 0.56190 | 16.0 |
| January 4 | 4 | 0.56070 | 16.2 |
| January 5 | 5 | 0.56100 | 16.1 |
| | 9 | 0.46275 | 16.2 |
| | 10 | 0.56275 | 16.3 |
| | 11 | 0.56265 | 16.5 |
| | noon | 0.56230 | 16.8 |
| | 1 | 0.56160 | 16.2 |
| | 2 | 0.56125 | 16.2 |
| | 3 | 0.56080 | 16.5 |
| | 4 | 0.56050 | 16.2 |
| | 5 | 0.56065 | 16.4 |
| | 6 | 0.56110 | 16.3 |
| | 7 | 0.56155 | 16.8 |
| | 9 | 0.56260 | 16.5 |
| | 10 | 0.56275 | 16.8 |
| | 11 | 0.56245 | 16.8 |
| January 6 | 8 ¹ / ₂ | 0.56315 | 16.2 |
| | 9 | 0.56300 | 16.1 |
| | 10 | 0.56295 | 16.1 |

OBSERVATIONS OF HORARY VARIATIONS BY M. BOUSSIN-
GAULT, AT SANTA FE DE BOGOTA (*Continuation*).

| | | Temp. of B. 16.2°C. | |
|-----------|----------------|----------------------|------|
| January 6 | 1 ^h | 0.56255 ^m | |
| | noon | 0.56205 | 16.5 |
| | 1 | 0.56155 | 16.5 |
| | 2 | 0.56115 | 16.5 |
| | 3 | 0.56080 | 16.3 |
| | 4 | 0.56070 | 16.5 |
| | 5 | 0.56070 | 16.2 |
| | 10 | 0.56255 | 15.8 |
| | 11 | 0.56255 | 15.8 |
| January 7 | 4 | 0.56145 | 15.9 |
| | 7 | 0.56275 | 16.0 |
| | 8 | 0.56300 | 16.1 |
| | 9 | 0.56300 | 16.0 |
| | 10 | 0.56295 | 16.1 |
| | 11 | 0.56260 | 16.0 |
| | noon | 0.56220 | 16.1 |
| | 1 | 0.56190 | 16.2 |
| | 2 | 0.56120 | 16.2 |
| | 3 | 0.56095 | 16.2 |
| | 4 | 0.56090 | 16.0 |
| | 5 | 0.56095 | 16.0 |
| | 6 | 0.56110 | 16.1 |
| | 10 | 0.56245 | 16.0 |
| | 11 | 0.56240 | 16.0 |
| January 8 | noon | 0.56145 | 16.0 |
| | 4 | 0.56015 | 15.9 |
| | 5 | 0.56050 | 16.0 |
| | 6 | 0.56075 | 16.1 |
| January 9 | 9 | 0.56220 | 15.9 |
| | 4 | 0.55965 | 16.1 |

RESULT OF THE OBSERVATIONS OF THE HORARY VARIATIONS MADE BETWEEN THE PARALLELS OF LATITUDE 25° SOUTH, AND 55° NORTH, FROM THE LEVEL OF THE OCEAN TO THE ELEVATION OF 1400 TOISES.

| ZONES. | Names of the observers. | LIMIT-HOURS. | | | | Mean extent of the oscillations of the barometer (in hundredths of millim.) | PLACES OF OBSERVATION. |
|----------|-----------------------------|------------------------|------------------------|-------------------|------------------------|---|--|
| | | Minima after midnight. | Maxima of the morning. | Minima afternoon. | Maxima of the evening. | | |
| EQUATOR. | Lamanon & Mongès. | — 4h | + 10h | — 4h | + 10h | .... | Equatorial and Atlantic Ocean. |
| | Humboldt & Bonpland. | — 4½h | + 9¼h | — 4½h | + 11h | 2.55 | Equatorial America, from 23° N. lat. to 12° S. lat between 0° and 1500 toises of elevation. |
| | Duperrey. | — 3h | + 9h | — 3½h | + 11¼h | 3.40 | Payta (on the coast of Peru), lat. 5° 6' south. |
| | Boussingault & Rivero. | ... — 4h | + 9½h + 9h | — 3½h — 4h | + 10h + 10h | 2.44 2.29 | La Guayra, lat. 10° 36' N. Santa Fe de Bogota (lat. 4° 35' N.) height 1366 t. |
| | Horsburgh. | — 4h | + 8½h | — 4h | + 11h | .... | Indian and African sea (lat. 10° N., 25° S. |
| | Langsdorff & Horner. | — 3½h | + 9¾h | — 4h | + 10½h | .... | Equatorial Pacific Ocean. |
| | Sabine. | — 5h | + 9½h | — 3¾h | + 10h | .... | Sierra Leone, lat. 8° 30' N. |
| | Kater. | — 5h | + 10½h | — 4h | + 10½h | .... | Table-land of Mysore, (lat. 14° 11' N. height 400 t.) Rainy season. |
| | Simonoff. | — 3½h | + 9½h | — 3½h | + 9¾h | .... | Pacific Ocean, from lat. 24° 30' N. to 25° 0' S.). |
| | Richelet. | — 5h | + 9h | — 5h | + 10h | .... | Macao, lat. 23° 12' N. |
| | Balfour. | — 6h | + 9¼h | — 6h | + 10h | .... | Calcutta, lat. 22° 34' N. |
| | Doria, Freycinet, Eschwege. | — 3h | + 9¼h | — 4h | + 11h | 2.34 | Equinoxial Brazil, at Rio Janeiro (lat. 22° 54' S.), and at the Missions of the Coroaos Indians. |
| | Hamilton. | .... | .... | .... | .... | .... | Table-land of Katmandoo (in India), lat. 27° 48' N. |

North and South Torrid Zone.

MEAN HEIGHT OF THE BAROMETER IN THE TROPICS,
AT THE LEVEL OF THE SEA.

Among the numerical elements of which physical geography has long required a precise determination, the mean height of the barometer at the level of the sea in the different zones, is one of the most important. This determination comprehends two questions entirely distinct: 1st. What is the mean absolute height of the barometer on the coasts of Europe, and of equatorial America? 2d. Is that height the same, or does it differ in the temperate and torrid zones? These problems have not hitherto been solved. The determination of the absolute height supposes the exact estimation of the effect of *capillarity*, that is, of the depression of the mercury in the tubes of the barometric basin. M. Arago has been occupied by these very delicate researches, in comparing the barometers of the construction of Fortin, with barometers with syphons. He will soon publish the results of this labor, which will be the more interesting from being linked with the question respecting the invariability of the mean weight of the atmosphere in a long lapse of ages. I shall here only treat of the difference of the mean barometric heights in the parallel of 49°, and in the equatorial regions. This research had

particularly fixed my attention at the period when I quitted Europe. I had carefully compared two of my barometers with that from which M. Bouvard published the meteorological variations made at the observatory of Paris. I thought I should find at Cumana * on the sea shore, the mean height of 337.8^h , or 762.02^{mm} , at 25° of the centigrade thermometer, which gives at the temperature of zero, 758.59^{mm} . As at this period (1799) the mean height at the level of the sea in Europe †, was supposed, ac-

* M. Caldas, whom sanguinary political re-actions snatched from the sciences at an age when he could still have rendered them much service, thinks that the difference of the mean height between my observation and that of Shuckburg, arises from the little accordance to be found between a column of mercury boiled, or not boiled in the tubes. (*Semanario*, Tom. i, p. 52.) This cause could not influence my observations at Cumana and La Guayra. I had brought from Europe to Caraccas two barometers, of which the mercury had been boiled in the tubes with the greatest care, by very able artists.

† M. Oriani finds, for Milan, the mean height on the coast of the Adriatic (at 13.5° cent. of temperature) 338.23^h , which gives 761.73^{mm} at the temperature of zero. The mean barometric height at the Havannah, according to M. Ferrer, is 25.7° cent. 338.55^h , or 763.71^{mm} , or at 0° temp. 760.18 . This result is identical with that of M. Boussingault; but we are ignorant of the elevation of M. Ferrer's barometer above the level of the ocean, and the precautions employed at Milan and the Havannah to know the capillarity of the tubes. See *Dei combustibili*, Memoria del Conti Bevelacque-Lanzisc,

according to Shuckburg, to be 761.18^{mm} (at the temperature of zero), I naturally concluded from that comparison, that the *barometric mean at the level of the sea in the torrid zone, was a little less than in the temperate* *. Uncertain with respect to the capillarity of the barometer I had employed, I estimated that difference at two millimeters in my *View of the Equinoxial Regions*, and which I attributed to the ascending movement of the tropical atmosphere, which bears the layer of air strongly heated, towards the polar regions. Having made, with my instruments, long journies by land from

p. 107. *Schumacher Astr. Nachr. Beil.*, Tom. ii, No. 65 ; *Hertha*, n. 3, p. 246. On the almost constant depression which the barometer undergoes near Cape Horn, where the western winds blow impetuously, see *Krusenstern, Rec. de Mém. hydr.*, Tom. i, p. 29 ; *Léopold de Buch* ; in *Gilbert, Ann der Physik.*, Tom. xxv, p. 230 ; *Id. Barometrische Windrose*, p. 4.

* See my *Essay on the Geography of Plants*, p. 90. In the first half of the 18th century, Richer, Bouguer, La Condamine, Ulloa, and Don Jorge Juan, believed that the barometer at the level of the equinoxial seas, was 27ⁱⁿ 11.5^{li} ; 28ⁱⁿ 0^{li}, or 28ⁱⁿ 1^{li}. The instruments used by those travellers had no doubt the air but very imperfectly expelled, for no correction being employed for the temperature, the barometric heights must have been found too great. If the mean barometric heights at the level of the seas of Europe, have been recently a little exaggerated, it is no doubt on account of the uncertainty that envelops the effect of capillarity.

Paris to Marseilles, Murviedro, Madrid, and Corogne, before I embarked for Cumana, I could have but little confidence in my determination. Fortunately, I can now substitute another far more precise. MM. Boussingault and Rivero, before they embarked for La Guayra, compared, conjointly with M. Arago, two excellent barometers of Fortin, with that of the observatory of Paris. The two barometers have preserved the same difference which they had in Europe. M. Boussingault found, at the level of the ocean at La Guayra, the mean of the *maxima* and *minima* observed during twelve days, to be 760.17^{mm} (at the temperature of zero). M. Arago, from nine years of observations at Paris, estimates the mean barometric height (reducing it to the temperature of zero, and the level of the Ocean *) at 760.85^{mm} . The difference of the two mean heights, determined as it were by the same instrument, rises consequently to 0.68^{mm} . We must not forget that in the torrid zone, accidental causes have also an influence on the mean height. I have tried to estimate carefully the probable limits of those changes; and it results from the ana-

* Mean bar. height at Paris, (Royal Observatory), 755.43^{mm} . Difference between the Observatory and the port of Havre, according to a year of correspondent observations made with compared instruments: 5.42^{mm} .

logy of well-observed facts, that even at La Guayra, in another season, the barometric mean, deduced from the *maxima* of 9^h, and the *minima* of 3½^h, might have been found a millimeter more or less. In order to leave no doubt on the question here agitated, we should be able to compare the mean of nine years at Paris, with the mean of one year on the coast of Venezuela. But hitherto we possess one whole year of horary observations for one place only in the tropical zone, between 0° and 15° of latitude ; that place is the table-land of Bogota, raised more than 2600 meters above the level of the equinoxial sea.

MEAN TEMPERATURE OF CUMANA. HYGROMETRIC
AND CYANOMETRIC STATE OF THE AIR.

During a stay of six months and a half at the town of Cumana (lat. 10° 27' 52'') I occupied myself simultaneously by researches, 1st. on the mean temperature of the place*, the increase of the heat at different hours of the day, the temperature of the sea during the flux and reflux †, the intensity of the heat of the

* See *Per. Nar.* Vol. iii, p. 386, 458, 568, and 569.

† *L. c.*, Vol. ii, p. 142, 184 ; Vol. iii, p. 545.

sun measured at different hours by the thermometers placed in the shade, and in the sun ; 2d. on the horary variations* of the barometer ; 3d. on the hygrometric †, electric, and cyanometric state ‡ of the atmosphere ; 4th. on evaporation ; 5th. on the quantity of rain that falls in different months ; 6th. on the declination and inclination of the loaded needle §, and on the intensity of the magnetic force ; 7th. on the mirage, and the influence which the rising and setting of the sun exerts on the inflexion of the trajectories ||. The preceding volumes contain a great number of the results which I obtained ; I shall here treat specially of the distribution of heat in the different months of the year, and of the hygrometric, cyanometric, and electric state of the air of Cumana. The experiments I made on the evaporation and intensity of the heat of the solar rays, will be developed later, and will serve as a term of comparison in the statement of the meteorological phenomena observed on the back of the Cordilleras of Quito and Mexico. I made observations at Cumana, with the thermometer, the whalebone

* *L. c.* Vol. vi, p. (631-770).

† Vol. ii, p. 91 ; Vol. iii, p. 54 ; Vol. iv, p. 145.

‡ *L. c.* Vol. ii, p. 95, 109 ; Vol. iii, p. 456.

§ Vol. iii, p. 322—325.

|| Vol. iii, p. 542—554.

hygrometer of Deluc, and the cyanometer of Saussure, during the months of July, August, October, and November 1799, and also during the month of August, 1800 ; not every day, but often, in order to seize the progressive increase better, ten or twelve times in the same day. During my journey to Caraccas, and the Oroonoko, I begged a very intelligent person, zealous in such researches, M. Faustin Rubio, to mark the indications of a thermometer of Dollond on a register, (and which was concordant with my thermometer to nearly 0.2° cent.) three or four times a day, to 7^{h} or 8^{h} in the morning, 2^{h} and 4^{h} in the afternoon, and 11^{h} at night. This thermometer was placed in the shade, in an airy spot, far from the reflexion of the soil, at the Faubourg of the Guayqueries Indians. Cumana being regarded as one of the hottest, driest, and healthiest places of the low regions of equinoxial America, it is important to make known these partial observations. I take them by chance, out of 1600 I possess ; they will serve, above all, to certify that the climate of the tropics is much more characterized by the *duration of the heat*, than by its intensity, that is, by the *maxima* of temperature which the thermometer attains on certain days. I never saw that instrument at Cumana, below 20.8° , nor above 32.8° cent. ; and I found on the registers of M. Orta, whose thermometers were

compared by mine, with those of the observatory at Paris, that at Vera Cruz, the *maximum* of heat in thirteen years, had only three times attained 32° cent., and once 35.7°; while we have seen the centesimal thermometer at Paris*, at 38.4°.

* See Arago, on the extreme temperatures observed at Paris, in the *Annuaire du Bureau des Long.*, for 1825, p. 164.

I. OBSERVATIONS OF M. DE HUMBOLDT.

| <i>July.</i> | <i>Th. R.</i> | <i>Hygr. Del.</i> | <i>Aug.</i> | <i>Th. R.</i> | <i>Hygr. Del.</i> |
|-------------------|---------------|-------------------|----------------|---------------|-------------------|
| 18 | | | 6 ^h | 18.7° | 54 _o |
| 8 ^h m. | 18.9° | 54° blue. | 7 | 18.5 | 55 cloudy. |
| 2 | 18.4 | 53 storm. | 8 | 18 | 59 blue. |
| 7 e. | 18.7 | -- blue. | mid. | 17.5 | 60.5 |
| 11 n. | 19.0 | 55 | 29 | | |
| 19 | | | 11 m. | 22.5 | 52 blue. |
| 6½ m. | 18.7 | 53 blue. | noon. | 24.5 | -- |
| 9 | 20 | 50 | 4 e. | 23 | 51 |
| 1 | 22 | -- | 4½ | 24 | 51 blue. |
| 2 | 22.4 | 49 storm. | 7 | 19.5 | 61 overcast. |
| 6 e. | 20.2 | 00 blue. | mid. | | 67 blue. |
| 24 | | | 30 | | |
| 7 m. | 19.8 | 60 blue. | 7½ n. | 21.1 | 51 blue. |
| noon. | 23 | 50 | noon. | 25.0 | 49 |
| 3 | 23.2 | 49.5 blue. | 2 | 26 | 47 storm. |
| 4½ | 22.5 | 50 | 8 e. | 19.2 | 56 blue. |
| 11 n. | 18.1 | 56 blue. | 11 | 19 | 60 |
| <i>Aug.</i> | | | mid. | 18.5 | 60.2 blue. |
| 17 | | | 31 | | |
| 5½ | 17 | 58 blue. | 8½ | 20.3 | 54 blue. |
| 9 | 21 | -- | 11 | 23 | 49 |
| 10½ | 22 | -- | noon. | 23.6 | 48 |
| 2 | 23 | 45 | 2 | 23.4 | 47.7 blue. |
| 4¾ | 20 | 48 storm. | 4 | 22.5 | 48 |
| 6 | 18 | 65 rain. | 11 n. | 19 | 50 |
| 11 | 18 | 60 blue. | mid. | 18.3 | 52 |
| 18 | | | | 18 | 56 blue. |
| 3 e. | 22.5 | 00 storm. | <i>Oct.</i> | | |
| 5 | 21 | 49 | 22 | | |
| 9 n. | 19 | 55 | 8 | 20.4 | 00 blue. |
| 10 | 18.5 | 57 clouds. | 10 | 21.5 | -- |
| 10½ | 18 | 59 blue. | noon. | 21.6 | -- |
| mid. | 18 | 62 blue. | 1 | 23.8 | -- |
| 26 | | | 2 | 23.9 | -- |
| noon. | 23 | 53 blue. | 2½ | 23 | 00 blue. |
| 3 e. | 23.3 | 48 | 3 | 22 | -- |
| 5 | 22.5 | 47.6 | 5 | 21.5 | -- |
| 7 | 20.3 | 51 blue. | 6 | 20.9 | -- |
| 11 n. | 18.1 | 53 wind. | 8½ | 19.2 | 00 mists. |
| mid. | 18.0 | 00 blue. | 10 | 19.2 | -- |
| 27 | | | mid. | 19.1 | 00 mists. |
| 8½ | 19.2 | 57.5 blue. | 23 | | |
| 9 | 19.5 | 57 | 8½ | 20.5 | 53.5 |
| 11½ | 22.5 | 49 clouds. | 10 | 22 | 52.5 |
| noon. | 24.0 | 48 | 1 | 24.3 | 49.5 |
| 2 e. | 23.5 | 47 storm. | 3 e. | 24 | 49.5 |
| 4 | 20 | 50.5 | 4½ | 22 | 50.3 |
| | | | 6 | 20.5 | 53 |
| | | | 11 n. | 20 | 56.1 |

(Continuation.)

| <i>Oct.</i> | <i>Th. R.</i> | <i>Hygr. Del.</i> |
|-----------------|---------------|-------------------|
| 24 | | |
| 10 ^h | 22° | 51.8° |
| 11 | 23 | 51 |
| noon. | 23.5 | 50.5 |
| 1 | 23.2 | 50 |
| 5½ | 19.5 | 52.5 |
| 6 | 19.2 | 54 |
| 10 | 18.8 | 55.5 |
| mid. | 18.6 | 56.5 |
| 25 | | |
| 9 | 21 | 52.5 |
| noon. | 22.4 | 50.5 |
| 2 | 23 | 49.8 |
| 5 | 19.3 | 52.2 |
| 10 n. | 19 | 62.3 |
| 26 | | |
| 9 | 20.5 | 53.5 |
| 2 e. | 23.2 | 50 |
| 5 | 20.2 | 52 |
| 9 | 20 | 54 |
| mid. | 18.2 | 56.5 |
| 27 | | |
| 8 | 20.2 | 52.6 |
| 11 | 21.5 | 51 |
| noon | 23.2 | 50 |
| 11 n. | 19.5 | 52.5 |
| <i>Nov.</i> | | |
| 3 | | |
| 9 | 21 | 54 |
| noon. | 22 | 51 |
| 2 | 23 | 49 |
| 6 | 20.5 | 58 |
| 4 | | |
| 9 | 22.4 | 49 |
| 2 e. | 23.2 | 48 |
| 5 | 22.5 | 54 |
| 7 | 21 | 60 |
| 11 n. | 19 | 66 |
| 5 | | |
| 10 | 22 | 54 |
| noon. | 22.5 | 50 |

| <i>Nov.</i> | <i>Th. R.</i> | <i>Hygr. Del.</i> |
|----------------|---------------|-------------------|
| 5 | | |
| 3 ^h | 23° | 49.4° |
| 4 | 20.2 | 50.2 |
| 5½ | 20.1 | 51.5 |
| 10 | 17.7 | 64 |

The thermometer, (division of Reaumur) is reduced to that of the cellars of the observatory at Paris, which, according to researches made after my return to Europe, was found 0.37° cent. too high. The hygrometer was of whalebone. These indications are not corrected by the temperature. On the night of the 17th of August, when the thermometer sank rapidly to 18°, at the same instant (by the cooling of the upper layers of the air) a fine halo was formed around the moon. On the 25th of August, during a furious north-east wind, the thermometer sank at 9^h in the evening to 17.5° R. This was the beginning of the small rains which form what the people of Cumana call the winter season.

Days considered as excessively hot at Cumana, 1799, and 1800,
 27 Aug. at noon 24.0° Reaumur.
 29 ————— 24.5
 30 ————— 26.0
 10 Oct. the whole
 day - - - - - 24.2
 the whole night 23.0
 26 March at 2^h - 25.7
 14 May at 4^h - - 26.0

When the thermometer at Cumana, has been at 23°-25° (hygr. 48° Deluc), during three days, we experience a feeling of cold when the thermometer descends after a storm of rain, to 18°-19° R. (hygrometer 62° Deluc). See above, Vol. ii. p. 252.

| <i>Sept.</i> | <i>Th. R.</i> | <i>Hygr.</i> | <i>Sept.</i> | <i>Th. R.</i> | <i>Hygr.</i> |
|-------------------|---------------|---------------|-------------------|---------------|--------------|
| 1 | | | 11 | | |
| 8 ^h m. | 20.8° | 82° Saussure. | 9 ^h m. | 20.2° | 41° |
| 10 n. | 20.7 | 86 | noon. | 22.9 | 30 |
| 2 | | | mid. | 19.3 | 40 |
| 9 m. | 21.3 | 78 | 12 | | |
| 3 e. | 22.2 | 82 | 8 m. | 20 | 37 |
| mid. | 20.7 | 84 | noon. | 24 | 31 |
| 3 | | | 11 n. | 21 | 38 |
| 10 m. | 22.5 | 76 | 13 | | |
| 1 aftn. | 20.9 | 83 | 5½ m. | 19 | 41 |
| 4 | | | noon. | 23.7 | 32 |
| 7 m. | 20.7 | 82 | 1 n. | 17.5 | 59 |
| 3 e. | 22.5 | 87 | 14 | | |
| 11 n. | 22 | 78 | 7 | 18 | 47 |
| 5 | | | noon. | 23 | 32 |
| 1 e. | 22.8 | 37 Deluc. | 11 n. | 18.7 | 49 |
| 3 | 23.0 | 36 | 15 | | |
| 11 n. | 22.5 | 37 | 5½ | 18.5 | 47 |
| 6 | | | 7 | 21 | 38 |
| 3 e. | 22.5 | 33.5 | 8 | 21.2 | 33 |
| 11 n. | 20.7 | 36 | 10 | 23 | 32 |
| 7 | | | noon. | 23.3 | 32 blue. |
| 5 m. | 19 | 43 | 3 | 19 | 70 rain. |
| 3 e. | 23.5 | 35 | 6 | 19.5 | 55 |
| 1 n. | 19.5 | 49 | 11 n. | 18 | 53 |
| 8 | | | 16 | | |
| 9 m. | 23.3 | 33 | 8 m. | 17.5 | 43 |
| 3 e. | 26.0 | 31 | 3 e. | 22.0 | 33 |
| 1 n. | 20.2 | 37 | 11 n. | 19 | 48 |
| 9 | | | | | |
| 9 m. | 23.5 | 27 blue. | | | |
| 10 n. | 22.5 | 45 rain. | | | |
| mid. | 18.3 | 50 blue. | | | |
| 10 | | | | | |
| 1 e. | 24.0 | 29 | | | |
| 3 | 19.7 | 37 rain. | | | |
| mid. | 18.8 | 50 | | | |
| 3 m. | 18.3 | 50 | | | |

From 1st to 4th September, hygr. of Saussure, from 5th to 16th September, hygr. of Deluc.

OBSERVATIONS OF THE CYANOMETER.

| <i>Days.</i> | <i>Cyanom.</i> | <i>Th. R.</i> | <i>Hygr.</i> | <i>Days.</i> | <i>Cyanom.</i> | <i>Th. R.</i> | <i>Hygr.</i> |
|-------------------|----------------|---------------|--------------|----------------|----------------|---------------|--------------|
| 18 Aug. | | | | 19 Aug. | | | |
| noon. | 21° | 22.4° | 38° Deluc. | 6½ | 15° | 16.7° | 40.7° |
| 29 noon. | 22 | 24.5 | | 7 | 16.8 | 17.5 | 39 |
| 30 noon. | 19 | 24.8 | | 7½ | 18 | 19.4 | 38.5 |
| 31 noon. | 16 | 21 | 38.9 | 8 | 20 | 19.5 | 37.4 |
| 11 Sept. | | | | 8½ | 20 | 21.2 | 36 |
| 7 ^h m. | 11.3 | 18 | 42 | 9 | 20.4 | 21.7 | 35 |
| 7¾ | 14 | 20.3 | 41.5 | 9½ | 19 | 22.6 | 33 |
| 8 | 13 | 20.2 | 41 | 11 | 18 | 23.5 | 30.2 |
| 9 | 14 | 22 | 36 | noon. | 18 | 23 | 29 |
| 10 | 14 | 23 | 31.5 | | | | |
| 11 | 17.7 | 22.9 | 30 | | | | |
| 3 e. | 18 | 23.6 | 30 | | | | |
| 14 | | | | | | | |
| 7 m. | 13.7 | 18 | 47 | | | | |
| 9 | 17 | 21.2 | 40 | | | | |
| 10 | 18 | 21.7 | 35.4 | | | | |
| noon. | 23 | 23.8 | 30 | | | | |
| 16 | | | | | | | |
| 8 m. | 14.5 | 17.5 | 43 | | | | |
| 9 | 18.5 | 20.8 | 41 | | | | |
| 11 | 19.5 | 22 | 34 | | | | |
| 18 | | | | | | | |
| 6¾ m. | 15 | 18.4 | 43 | | | | |
| 7 | 16.3 | 19.2 | 41.7 | | | | |
| 7¾ | 17.0 | 20.3 | 41 | | | | |
| 8 | 17.8 | 21.3 | 40 | | | | |
| 9 | 17 | 21.4 | 38.2 | | | | |
| 9½ | 18 | 21.7 | 36 | | | | |
| 11 | 22 | 23.5 | 32 | | | | |
| noon. | 22 | 23.8 | 29 | | | | |
| 1 | 23 | 24.5 | 29 | | | | |
| 3 | 17 | 24.3 | 32 | | | | |

The observations of the cyanometer were extremely fatiguing, on account of the intensity of the light in those regions. Calm and serene days were chosen. The observation always at the zenith, or near the zenith. When the wind rises, the tint of the sky becomes a little paler, without any change in the hyg., or the vesicular vapors becoming visible. The colour of the sky is generally at Cumana, from 22° to 24° at noon, by the cyanometer of Saussure, while at Paris (by 20° R. of temperature) it is most frequently 16°. Sometimes (the 31st of August, and the 19th of September) the sky was singularly pale, without there being the least breath of wind. *See above, vol. ii. p. 95, 109.*

Often, in a very strong wind, we enjoyed an extraordinary coolness, although the thermometer had only lowered 1.5° R., and the hygrometer of Deluc had moved but 3° towards the point of extreme humidity. The stars do not scintillate at Cumana, above 25° of elevation; yet on the 24th and 26th of October, the scintillation became very sensible to the zenith, when the thermometer had descended rapidly to 18.5° R. The scintillation seems to augment at Cumana, less by the humidity, than by a sudden cooling, and by ascending and descending currents that mix layers of air of very different densities. The hygrometer indicates so little scintillation, that I have seen it pass from 50° to 59° , even to 62° (division of Deluc), and yet the stars, far from scintillating, preserved, below 25° , their tranquil and planetary light. These phenomena confirm the ingenious explanation given by M. Arago, of scintillation. (Vol. iii, p. 313—315, 538; Vol. iv, 94, 467). No hail ever falls at Cumana, although the electric explosions are frequent two hours after the *maximum* of heat. When the thermometer was 24° R. in the air, the coolest water which the inhabitants prepared by evaporation (by exposing it to the currents of air, in pots that transude a little), was 21° R. Mr. Chisholm says "I never could refresh water within the tropics, in vases, below 72° Fahr." (17.7° R.)

Some delicate experiments which I tried, to verify the point of extreme humidity of my whalebone hygrometer, at the moment of my departure from Cumana for Caraccas, led me to suspect that towards the end of October, that instrument indicated 1.8° of too great humidity. The 50th degree of my hygrometer of Deluc, was perhaps equal only to 84.7° of the hair hygrometer, while the 50° of an hygrometer of Deluc, well rectified in those extreme points, make 85.5° of the hair hygrometer of Saussure. The 5th of September, at 3^h in the afternoon (th. 23° R.; hydr. 36° Del.), I saw *large drops of rain* fall from a sky quite blue, and without any traces of clouds. The same day, between noon and 3^h, the thermometer rose, in the streets of Cumana, in the shade, but exposed to the reflection of the edifices, five feet above the soil, to 29° R. (36.2° cent.). *The inhabitants of Cumana are exposed to that heat during the greater part of the year, in the open air, in the streets, and great squares, on a white and powdery soil.* When the mean temperature of the day (from sun-rise to sun-set, without reckoning the night), is 22° - 24° R., great coolness is enjoyed between 17° - 19° R. (21.8° - 23.7° cent.). In the driest time, during the night, (at 19° R.), the hygrometer of Deluc often keeps up at 30° (65.3° Saussure). Sunrise makes the hygrometer move to humidity, but very slowly. The

17th September, the hygrometer of Deluc, at 4^h in the morning, 44.7° (th. 17.9° R.). During twilight, which lasts but some minutes, hydr. 45.5° (th. 17.5°). The evaporation caused by the first unreflected rays of the sun produces cold. At 6^h, a little wind is felt, as in Europe; hydr. 44.5° (th. 17.8°); at 6½^h, hydr. 38°. The 19th September, hydr. at midnight, 35° (th. 19.4°); at 4^h in the morning, hydr. 39° (th. 19°); at 6^h in the morning, hydr. 41° (th. 22° R.). In examining the whole of my hygrometric observations at Cumana, I find 22° R. (27.5° cent.) of temperature.

Mean of the day, July 47.6° of night 56.2° of 24^h 51.9°

| | | |
|-----------|------|------|
| Aug. 45.4 | 58.0 | 51.7 |
|-----------|------|------|

| | | |
|-----------|------|------|
| Oct. 46.7 | 55.7 | 51.4 |
|-----------|------|------|

| | | | |
|------------------|------|------|-------------|
| Mean of 3 months | 46.6 | 56.7 | 51.7 Deluc. |
|------------------|------|------|-------------|

| | | | |
|----|------|------|-------------|
| or | 83.5 | 89.1 | 86.3 Sauss. |
|----|------|------|-------------|

At Geneva, the mean of 1796-1802 also yields 82.3° of the hygrometer of Saussure, but by 9.6° cent. of temperature. When the estimates of the atmospheric humidity in degrees of the hygrometer of Saussure, draw near each other (between 83°-89°), the arithmetical mean differs very little from the real hygrometrical mean. The error would become serious between 70° and 90°, as we may be convinced in examining the table of the tension of the vapors, founded

on the fine experiments of M. Gay-Lussac. During several singularly dry days in the month of September, I saw the hair hygrometer descend at Cumana to 64° (29.5° of the whale-bone hygrometer), at a temperature of 28.7° cent.

Rains and Storms.

The rainy season, which in other parts of the tropics yields 100 to 115 inches of water (Vol. vi, p. 276) per year, produces scarcely seven to eight inches at Cumana. I collected in September and October (rainy season):

| | |
|-------------------|-------------------|
| August 31 | 3.2 ^{li} |
| September 8 | 2.0 |
| 9 | 5.4 |
| 12 | 6.1 |
| 15 | 2.1 |
| 16 | 6.7 |
| 18 | 3.8 |
| 30 | 0.7 |
| October 2 | 8.8 |
| 4 | 13.7 |
| 6 | 3.3 |
| 22 | 10.5 |
| 24 | 0.9 |
| 28 | 4.2 |
| 30 | 0.9 |

72.3 lines, or 0.163^m.

The most violent showers produced partially 14 lines of water, which falls in drops of an enormous size; and this characterizes the small rains of the tropics, that they fall in drops which remain at a great distance from each other. There have been years (1798 and 1799), when during nine months, from December to September, the rains did not yield two inches of water. In the New Continent, the drought of Cumana, Punta Araya, and the island of Marguerita, can be compared only with the province of Ciara in Brazil, where sometimes (1792-1796) it does not rain during several years. (*Corogr. Bras.* ii, p. 221.) The vegetation, notwithstanding the drought, is fresh at Cumana, for instance, near the *Chara de Capuchinos*. The dew is almost null; the little water that falls at Cumana descends in showers with extraordinary rapidity; these showers last in general but from fifteen to twenty minutes. I saw $4\frac{1}{2}$ lines at the *maximum*, fall in six minutes. All my measurements were made in cylindric vases, and in such a manner that the evaporation could not lead to error. During the great storm of September 16th, 1802, at Cumana, I placed two cylindric ombrometers, at heights which differed only twenty-two feet perpendicularly. It rained with violence from 3^h 25' to 4^h 5'; I found in the most elevated ombrometer, $6\frac{7}{10}$ lines of water, and in the

lowest, $7\frac{1}{2}$. Doctor Heberden has seen differences as far as fifteen feet in height. I remarked no difference on the 28th September, and the 2d of October, between the two stations of the ombrometer. The rains of these countries are electric, and are preceded by very sensible signs of electricity on the electrometer of Volta, armed with a burning wick. What struck me above all at Cumana, was, that a few minutes before the rain fell, the hair hygrometer continued not only to indicate 67° to 68° , which is a considerable drought for that country, but that (without any change of temperature) it *retrogrades* one to two degrees towards drought, in proportion as the sky becomes obscure, and takes that intensity of dark blue which precedes the electric explosions. At Cumana, the words *thunder*, *winter*, and *rain* (*trueno*, *invierno*, *aguasero*,) are synonymous. The thermometer, while it rains, goes down from 24° R., at the utmost to 19° . The sky, in darkening, remains uniformly blue, displays no vapors divided into groupes, and acquires an intensity of colour that goes to 47° of the cyanometer. The cocoa-trees, and all the plants with glossy leaves, are detached in *light* on the azure vault, and appear suddenly to draw nearer to the observer: a perfect calm reigns in the air. The atmospheric electricity, which I found generally null at Cumana, from 7^h in the morning

till 2^h in the afternoon, in trying it with the electrometer of Volta, on a terrace thirty feet high, and entirely open, becomes suddenly so strong that the divergence of the balls rises to eight lines, and it is soon no longer necessary to arm the instrument with a wick. The electricity often passes from positive to negative, without thunder being heard. In a great number of storms the electric charge of the air appeared to me to be negative twenty minutes before the strongest explosions, although I made my experiments far from any trees, in the middle of the *Salado*, in a vast plain. The rain that falls during the storm, is sometimes of the temperature of 17.8° ; and I then found it a degree colder than the air, at the moment of the shower. Having made many experiments in the open country, in temperate climates, at Salzbouurg, Bayreuth, Vienna, Marseilles, and Corogne, I can affirm that the electric charge, which becomes sensible within the tropics, during the storm, in the low regions of the air, is of surprising intensity. After three quarters of an hour of storm, lightening, and rain, I saw in the electrometer of Volta, without the conductor being armed with a wick, a separation of the balls of ten lines. Often, at the instant of the thunder, the electricity does not change from + into —, or from — into +; sometimes these passages are not accompanied with any

explosion ; at other times the electricity which was positive 14 lines, becomes suddenly zero at the instant of the thunder, remains null during four or five minutes, and again becomes positive. The great electric clouds appeared to me in general to be much more elevated in the torrid zone than in Europe, and the people believe that the thunder much more rarely reaches the earth.

II. OBSERVATIONS OF DON FAUSTINO RUBIO.

I shall give only the partial observations in degrees of the thermometer of Fahrenheit, for the two months of January and May, of which the mean temperature differs most.

JANUARY, 1800.

| DAYS. | THERMOMETER at 7 ^h in the morning. | THERMOMETER at 2 ^h in the afternoon. | THERMOMETER at 11 ^h at night. |
|-------|---|---|--|
| 3 | 78° | 82° | 81° |
| 4 | 78 | 85 | |
| 5 | 79 | 83 | |
| 6 | 77 | 84 | 80 |
| 7 | 76 | 82 | 80 |
| 8 | 76 | 82 | 80 |
| 9 | 80 | 85 | 81 |
| 10 | 80 | 84 | 80 |
| 11 | 78 | 83 | 80 |
| 12 | 80 | 83 | 80 |
| 13 | 79 | 83 | 78 |
| 14 | 74 | 82 | 79 |
| 15 | 76 | 82 | 80 |
| 16 | 77 | 82 | 80 |
| 17 | 76 | 83 | 80 |
| 18 | 76 | 85 | 81 |
| 19 | 78 | 84 | 80 |
| 20 | 78 | 84 | 80 |
| 21 | 79 | 85 | 80 |
| 22 | 75 | 83 | 80 |
| 23 | 76 | 83 | 80 |
| 24 | 75 | 83 | 80 |
| 25 | 78 | 85 | 80 |
| 26 | 79 | 85 | 80 |
| 27 | 78 | 84 | 80 |
| 28 | 77 | 83 | 81 |
| 29 | 76 | 84 | 81 |
| 30 | 78 | 85 | 80 |
| 31 | 76 | 82 | 79 |

(Continuation).

OBSERVATIONS OF DON FAUSTINO RUBIO.

MAY, 1800.

| DAYS. | THERMOMETER at 7 ^h in the morning. | THERMOMETER at 2 ^h in the afternoon. | THERMOMETER at 11 ^h at night. |
|-------|---|---|--|
| 1 | 81° | 89° | 84° |
| 2 | 82 | 87 | 84 |
| 3 | 82 | 89 | 84 |
| 4 | 81 | 88 | 84 |
| 5 | 82 | 88 | 84 |
| 6 | 82 | 88 | 85 |
| 7 | 82 | 89 | 85 |
| 8 | 82 | 89 | 84 |
| 9 | 81 | 88 | 83 |
| 10 | 81 | 87 | 83 |
| 11 | 82 | 86 | 83 |
| 12 | 81 | 88 | |
| 13 | 82 | 88 | 86 |
| 14 | 81 | 90 | 86 |
| 15 | 81 | 89 | 86 |
| 16 | 81 | 88 | 84 |
| 17 | 81 | 89 | 84 |
| 18 | 81 | 88 | 83 |
| 19 | 82 | 89 | 83 |
| 20 | 81 | 86 | 81 |
| 21 | 81 | 88 | 83 |
| 22 | 80 | 88 | 83 |
| 23 | 82 | 88 | 83 |
| 24 | 80 | 88 | 83 |
| 25 | 81 | 89 | 83 |
| 26 | 79 | 89 | 82 |
| 27 | 80 | 88 | 84 |
| 28 | 82 | 87 | |
| 29 | 8 | 88 | 83 |
| 30 | 82 | 87 | 82 |
| 31 | 73 | 86 | 83 |

The uniformity of the temperature at the same hours is very remarkable; in the same two months, according to the very precise observations of MM. Boussingault and Rivero, in the climate of Bogota, called *extremely variable*, the centigrade thermometer varies in the different days, but 1° or 1.5°. It results from the whole of these observations, of which I am in possession, that we may admit for

CUMANA (5 t.)

| | |
|-----------------------------------|-------------|
| Mean temperature of the year..... | 27.7° cent. |
| The hottest month | 29.1 |
| The coldest month | 26.2 |

S. FE DE BOGOTA (1366 t.)

| | |
|-----------------------------------|-------------|
| Mean temperature of the year..... | 14.6° cent. |
| The hottest month | 16.8 |
| The coldest month | 14.4 |

The observations from the 19th of November to the 26th of August only, give for Cumana, employing only the *minimum* of 7^h in the morning, and the *maximum* of 2^h in the afternoon :

| MEAN OF THE MONTHS. | | EXTREME TEMPERATURE. | |
|---------------------|-------------|----------------------|----------------|
| | | <i>maxima.</i> | <i>minima.</i> |
| November | 22.76° R. | 24.8° R. | 23.1° R. |
| December | 21.70 | 24.0 | 21.7 |
| January | 21.49 | 23.5 | 22.2 |
| February | 21.56 | 24.4 | 22.2 |
| March | 21.20 | 25.3 | 23.1 |
| April | 23.04 | 25.7 | 23.5 |
| May..... | 23.35 | 26.2 | 24.2 |
| June..... | 22.71 | 24.8 | 21.3 |
| July | 21.79 | 24.4 | 21.3 |
| August..... | 22.00 | 24.8 | 22.2 |
| Mean... | 22.16 R. | 24.8 R. | 22.5 R. |
| or | 27.60 cent. | 30.9 cent. | 28.7 cent. |

Perhaps the general mean of Cumana is some decimals more, because the temperature of the months of September and October a little exceeds that of the month of August. The mean of the extreme (*maxima*) of heat, surpasses only 3.3° cent. the mean of the whole year. In comparing the mean temperature of three towns of the republic of Columbia in which a great number of meteorological observations have been made, we find, Cumana (lat. 10° 27'; height 5 toises), 27.7° cent.; Caraccas (lat. 10° 31'; height, 480 t.) 21.5°; Santa Fe de Bogota (lat. 4° 35'; height, 1366 t.) 14.6°. At the extremity of the torrid zone, at the Havannah (lat. 23° 10') the mean temperature of the air differs very little (2.1° cent.) from the mean

temperature of Cumana ; but the difference of the coldest month in these two places is 5°. (See above, Vol. iii, p. 386 and 463.)

ADDITIONAL NOTE ON THE HEIGHT OF THE LAKE OF
NICARAGUA ABOVE THE LEVEL OF THE SEA.

In discussing above, the obstacles which may prevent the possibility, and even the utility of an *oceanic canal*, (similar to the Caledonian canal, and the canal recently completed in North Holland,) between the eastern and western coasts of America, I spoke of the great height of the basin of Nicaragua. I regretted at the same time, that since my return to Europe, no precise measurement has been made in the isthmus of Huasacualco, Nicaragua, Panama, and the Atrato. (Vol. vi, p. 241, 253, 269, 281.) It is only at the moment when these sheets are about to appear, that I have had a communication of a very important document, which proves that, “ by order of the court of Madrid, addressed to the captain-general of Guatemala, Don Matis de Galvez, the engineer Don Manuel Galisteo executed a survey, in 1781, by means of a water level, from the gulph of Papagayo, on the coast of the South-Sea, as far as the Laguna de Nicaragua ; and that, by three hundred and thirty-six stations of ascent, and three hundred and thirty-nine stations of des-

cent, (*ascensos* : 604^{ft} 8ⁱⁿ 8^{li}, Castille measure ; *descensos* : 470^{ft} 1ⁱⁿ 7^{li}), the surface of the lake of Nicaragua was found to be elevated 134^{ft}. 7ⁱⁿ 1^{li} above the South Sea. But the lake is 88^{ft} 6ⁱⁿ deep ; so that its bottom is still 46 Castillian feet above the level of the South Sea. The Rio Panaloya, by which the lake of Leon communicates with the lake of Nicaragua, presents a bar (*salto*) of from 25 to 30 *varas*." (According to M. Ciscar, 1 *vara castellana* = 3 feet of Burgos = 0.429^t.) This document does not mark the direction and the extreme point of the line of levelling, its object being only the determination of the height of the lake ; it does not appear to be hitherto proved that the ridge of partition has every where the great elevation of 85 toises ; and that between Realejo and Leon, the gulph of Papagayo, or that of Nicoya, and the lake of Nicaragua, there exists no depression of soil, no transversal valley fit to receive the waters of a canal of great navigation. In the survey made by the commandant of the castle of Omoa, Don Ignaicio Maestre, and the engineers Don Joaquim Ysasy, and Don Jose Maria Alejandro, it was affirmed that the lake of Nicaragua has no natural communication with the South Sea ; it was observed at the same time, that the mountainous land (*aspero y montuoso*), between the Villa of Grenada, and the port of Culebra, renders all communication

by canals extremely difficult, if not impossible on that point. According to the testimony of Captain Cochrane, (*Journal of a Residence and Travels in Columbia during the years 1822 and 1824*, Vol. ii, p. 448), three ranges of hills separate the bay of Cupica, and the banks of the Naipi. (See above, Vol. vi, p. 250.)

is entirely contrary to the spirit of the law, and is
 on that point - according to the intention of
 the Legislature - a violation of the law, and
 is therefore a crime, and is punishable as such.
 It is also a crime, and is punishable as such,
 inasmuch as it is a violation of the law, and
 is therefore a crime, and is punishable as such.
 It is also a crime, and is punishable as such,
 inasmuch as it is a violation of the law, and
 is therefore a crime, and is punishable as such.

BOOK X.

CHAPTER XXVII.

Passage from the Coast of Venezuela to the Havannah.—General View of the Population of the West Indies, compared with the Population of the New Continent, with respect to the Diversity of Races, Personal Liberty, Language, and Worship.

SINCE the improvement of the art of navigation, and the increasing activity of commercial nations, have drawn the coast of the two continents nearer to each other; since the Havannah, Rio Janeiro, and Senegal scarcely appear to us more distant than Cadiz, Smyrna, and the ports of the Baltic, we hesitate in calling the attention of the reader to a passage from the coast of Caraccas to the island of Cuba. The Caribbean Sea is like the basin of the Me-

diterranean; and if I here note some observations drawn from my nautical journal, it is that I may not lose the thread of my narrative, and to recall some facts that are connected with meteorology and physical geography in general. In order to know well the modifications of the atmosphere, they must be studied on the declivity of mountains, and in the immensity of seas; there is no passage however short, no voyage even to the Canaries, or the Madeira islands, which may not give rise to new views in the minds of naturalists long accustomed to interrogate nature in the retirement of their study.

We sailed from the road of Nueva Barcelona on the 24th of November, at nine in the evening; and doubled the small rocky island of Borachita; there is a very deep passage between this island and the Gran Boracha. The night had that coolness which characterizes the nights of the tropics, and of which the agreeable effect can only be conceived by comparing the nocturnal temperature from 23° to 24° cent., with the mean temperature of the day, which in those latitudes is generally, even on the coast, from 28° to 29° . The next day, soon after the observation of noon, we reached the meridian of the island of Tortuga: destitute of vegetation, similar to the small isles of Cooke and Cabagua, it is remarkable for its

small elevation above the level of the waters. Some doubts having been recently thrown on the astronomical position of Tortuga, I shall here state that, by the time-keeper of Louis Berthoud*, the centre of the island was $0^{\circ} 49' 40''$, west of Nueva Barcelona. I believe that longitude to be a little too westerly.

November 26th.—A dead calm, so much the more unexpected, that in general the breeze from the eastward blows fresh on this coast from the beginning of November, while from the month of May till October, the N.W. and S. winds are felt occasionally. At the period of the N.W. wind, a current † is observed running from west to east, which sometimes favors during two or three weeks, the direct navigation from Carthagena to the island of Trinidad. The south-wind is regarded as very unhealthy on all the coast of the continent, bringing (as the people say), the putrid emanations of the forests of the Oroonoko. Towards 9^h in the morning a fine halo was formed around the sun, at the moment when the temperature in the low regions fell suddenly three degrees and a half. Was this lowering the effect of a descending current? The zone that formed the halo, and which had one degree of breadth, was

* *Obs. Astr., Intr.*, p. 42; and Vol. ii, p. 2.

† *Per. Nar.*, Vol. iii, p. 378.

not white, but displayed the most beautiful colours of the rainbow, while the interior of the halo, and the whole vault of the sky was azure, without any trace of visible vapors.

We began to lose sight of the island of Marguerita, and I endeavoured to verify the height of the rocky groupe of Macanao. It appeared under an angle of $0^{\circ} 16' 35''$; which, in a distance estimated at sixty miles, would give the groupe of mica-slate of Macanao the elevation of about 660 toises, a result * which, in a zone where the terrestrial refractions are so constant, leads me to think that the island was less distant than we supposed. The dome of the Silla of Caraccas, remaining 62° S.W. long drew our attention. We contemplate with pleasure the summit of a lofty mountain which we have climbed with danger, and which sinks gradually below the horizon. When the coast is not loaded with vapours, the Silla must be visible at sea, without counting the effects of refraction, at thirty-three leagues distance †. During that day, and the three following days, the sea was covered with a bluish skin, which, examined by a compound microscope, appeared formed of an innumerable quantity of filaments. We frequently find these filaments in the Gulf-stream,

* Vol. ii, p. 45 ; Vol. vi, p. 498.

† Vol. iii, p. 506.

and the Channel of Bahama, as well as near the coast of Buenos Ayres. Some naturalists think they are the vestiges of the eggs of mollusca: they appear to me to be rather the fragments of fuci. The phosphorescence of sea-water seems to be augmented, however, by their presence, above all, between the 28° and 30° of north-latitude, which indicates an origin of an animal nature.

November 27th.—We approached slowly the island of Orchila; like all the small islands in the vicinity of the fertile coast of the continent, it has remained uninhabited. I found the latitude of the north cape, $11^{\circ} 51' 44''$, and the longitude * of the eastern cape, $68^{\circ} 26' 5''$ (supposing Nueva Barcelona $67^{\circ} 4' 48''$). Opposite the western cape is a small rock against which the waves beat turbulently. Some angles taken with the sextant, gave, for the length of the island from east to west, 8.4 miles (950 toises); for the breadth scarcely three miles. The island of Orchila, which, on account of its name, I figured to myself as a bare rock covered with lichens, displayed at that period a beautiful verdure. The hills of gneiss were covered with gramina. It appears that the geo-

* *Astr. Obs.*, Vol. ii. p. 3. Nearly the longitude of Purdy's map (1823), and the latitude of the map of the *Dep. de Madrid* (1809).

logical constitution of Orchila resembles, on a small scale, that of Marguerita; it is composed of two groupes of rocks joined by a neck of land; it is an isthmus covered with sand, which, seems to have issued from the floods by the successive lowering of the level of the sea. The rocks, like all those which are perpendicular, and insulated in the middle of the sea, appear much more elevated than they really are, for they scarcely attain from 80 to 90 toises. The *Punta rasa* stretches to the north-west, and is lost like a sandbank below the waters. It is dangerous for navigators, like the *Mogote*, which, at the distance of two miles from the western cape, is surrounded by breakers. In examining these rocks very near, we saw the strata of gneiss inclined towards the north-west, and crossed by thick layers of quartz. These layers have no doubt given place by their destruction, to the sands of the surrounding beach. Some clumps of trees shade the vallies; the summits of the hills are crowned with palm trees with fan-leaves. It is probably the *Palmo de sombrero* * of the Llanos (*corypha tectorum*). The rains are not abundant in these countries; it is probable, however, that some springs might be found on the island of Orchila, if they were sought for with the same

* See our *Nova Genera Plant. Equin.*, Tom. i, p. 299.

care as in the rocks of mica-slate of Punta Araya. When we recollect how many bare and rocky islands are inhabited and cultivated with care between the 17° and 26° of latitude in the archipelago of the Little Antilles and the Bahama islands, we are surprised to find the islands near the coast of Cumana, Barcelona, and Caraccas, desert. They would long have ceased to be so had they belonged to any other government than that which is in possession of the continent. Nothing can engage men to circumscribe their industry within the narrow limits of an island, when a neighbouring continent offers them greater advantages.

We perceived at sunset, the two points of the *Roca de afuera*, rising like towers in the midst of the Ocean. A survey taken with the compass, placed the most easterly of the *Roques* at $0^{\circ} 19'$ west of the western cape of Orchila. The clouds remained long accumulated over that island, and shewed its position from afar. The influence of a small track of land in condensing the vapours suspended at an elevation of 800 toises, is a very extraordinary phenomenon, although familiar* to all mariners. From this accumulation of clouds, the position of the

* Henry Stubb, in the *Phil. Trans.*, 1667, No. 27, p. 497 and 718. Courejolles, in the *Journ. de Phys*, Vol. liv, p. 109.

lowest island can be recognized at a great distance.

November 29th.—We still saw very distinctly at sunrise, the summit of the Silla of Caraccas almost touching the horizon of the sea. We believed we were 39 or 40 leagues distant, which, regarding the height of the mountain as being well determined (1350 toises), its astronomical position, and that of the ship, would indicate rather a strong refraction for that latitude, between 1-6th and 1-7th. At noon, every thing denoted a change of weather towards the north; the atmosphere* suddenly cooled to 12.8° , while the sea preserved a temperature of 25.6° , at its surface. At the moment of the observation of noon, the oscillations of the horizon, crossed by streaks or black bands of very variable size, produced changes of refraction† from 3' to 4'. The sea became rough in very calm weather, and every thing announced a stormy passage between the island of Cayman and the cape Saint Antoine. On the 30th of November, the wind veered suddenly to N.N.E., and the surge rose to a considerable height. The sky displayed on the north a darkish blue

* The temperature is estimated by the centesimal thermometer wherever the contrary is not expressly indicated.

† I estimate those changes by the quantity which the height of the sun suddenly augmented after its passage by the meridian.

tint: the rolling of our small vessel was violent, and we perceived amidst the dashing of the waves, two seas crossing each other, one from the N. and the other from N.N.E. Water-spouts were formed at the distance of a mile, and were carried rapidly from N.N.E. to N.N.W. Whenever the water-spout drew near us, we felt the wind grow sensibly cooler. Towards the evening, by the carelessness of our American cook, the deck took fire; it was happily soon extinguished; for in bad weather, accompanied by squalls, and with a cargo of meat, which the fat renders extremely combustible, the fire would have made a rapid progress. In the morning of the 1st of December, the sea sunk slowly, as the breeze became fixed from N.E. I was at this time pretty certain of the uniform movement of my chronometer; but of this the Captain wished to be assured by the survey of some points of the island of Saint Domingo. On the 2d December we descried Cape Beata, in a spot where we had long marked the clouds heaped together. According to the heights of Achernar, which I obtained in the night, we were sixty-four miles distant. The night displayed a very curious optical phenomenon, which I shall not undertake to explain. It was half an hour past midnight; the wind blew feebly from the east; the thermometer rose to 23.2° , the whalebone hy-

grometer was at 57° . I had remained upon the deck to observe the culmination of some great stars. The full-moon was very high; suddenly, on the side of the orb, $45'$ before its passage over the meridian, a great arc was formed tinged with all the prismatic colours, but of a gloomy aspect. The arch appeared higher than the moon; this iris-band was near 2° broad, and its summit seemed to rise nearly from 80° to 85° above the horizon of the sea. The sky was singularly pure; there was no appearance of rain; and what struck me most was, that this phenomenon, altogether resembling a lunar rainbow, was not opposite to the moon. The arch remained stationary, or at least appeared to do so, during eight or ten minutes, and at the moment when I tried if it were possible to see it by reflection in the mirror of the sextant, it began to move and descend, crossing successively the Moon and Jupiter, placed at a small distance below the Moon. It was $12^h 54'$ (real time) when the summit of the arch sank below the horizon. This movement of a coloured arch filled with astonishment the mariners who were upon their watch on the deck; they pretended, as they do on the appearance of every extraordinary meteor, that "it announced wind." M. Arago examined the sketch of this arch in my journal, and thinks that the image of the moon reflected in the waters would not

have given a halo of so great a dimension. The rapidity of the movement is not a small obstacle to the explanation of a phenomenon well worthy of attention.

December 3d.—We had some uneasiness on account of the proximity of a small vessel which was believed to be a pirate, but as it drew near was recognized for the *Balandra del Frayle* (the sloop of the Monk). I could scarcely conceive what so strange a denomination meant. The bark belonged to a Franciscan missionary (*Frayle Observante*), a rich priest of an Indian village in the savannahs (Llanos) of Barcelona, who had for several years carried on a very lucrative contraband trade with the Danish islands. M. Bonpland, and several passengers, saw in the night at the distance of a quarter of a mile, with the wind, a small flame on the surface of the Ocean; it ran towards the S.W. and lighted up the atmosphere. No shock of earthquake was felt, and there was no change in the direction of the waves. Was it a phosphoric gleam produced by a great heap of mollusca in putrefaction; or did this flame issue from the depth of the sea, as is said to have been sometimes observed in latitudes agitated by volcanoes? The latter supposition appears to me destitute of all probability. The volcanic flame can only issue from the deep when the rocky bottom of the

Ocean is already heaved up, so that the flames and incandescent scoria escape from the swelled and creviced part, without traversing the waters.

December 4th.—At half past ten in the morning we were in the meridian of Cape Bacco (*P^{ta} Abacou*), which I found at $76^{\circ} 7' 50''$, or $9^{\circ} 3' 2''$, west of Nueva Barcelona. In time of peace the vessels that trade in dried meat (*tasajo*) between Cumana and Barcelona, or the Havannah, set out, according to the antient practice of the Spanish mariners, by the channel of Portorico, to take the *old channel*, on the north of the island of Cuba; sometimes also they pass between cape Tiburon and cape Morant, going along the northern coast of Jamaica. But in time of war, these passages become alike dangerous, the ship remaining too long in sight of land. Having attained the parallel of 17° , the fear of pirates made us prefer the direct passage across the bank of Vibora, better known by the name of *Pedro Shoals*. This bank occupies more than 280 square marine leagues, and its configuration strikes the eye of the geologist, on account of its resemblance to that of Jamaica, which is in its neighbourhood. It seems like a heaving up of the bottom which could not attain the surface of the sea, and forms an island almost as large as Portorico. From the 5th of December, the pilots believed

they took successively the measurement at a distance of the island of Ranas (*Morant Kays*), Cape Portland, and Pedro Kays. They were probably deceived in several of these distances, taken from the top of the mast. I have elsewhere noted these measurements*, not to put them in opposition to the great number which have been made by able English navigators, in these frequented latitudes, but merely to connect, in the same system of observations, the points I determined in the forests of the Oroonoko, and the archipelago of the West Indies. The milky color of the waters warned us that we were on the eastern part of the bank; the centigrade thermometer, which at a distance from the bank had kept up, on the surface of the sea, for several days at 27° and 27.3° (the air being at 21.2°), cooled suddenly to 25.7° . The weather was bad from the 4th to the 6th of December; it rained fast; the thunder rolled at a distance, and the gusts from N.N.E. became more and more violent. We were for some time of the night in a critical position; we heard before the prow the noise of the breakers over which we had to pass, and we ascertained their direction by the phosphoric gleam reflected by the foam of the sea; the scene resembled the Raudal of Garzita, and

* *Astr. Obs., Introd.*, Vol. i, p. xliii; Vol. ii, p. 7-10.

other rapids which we had seen in the bed of the Oroonoko. The captain accused less the negligence of the pilot, than the imperfection of the charts. We succeeded in turning our course, and in less than a quarter of an hour we were out of danger. The soundings indicated first 9, then 12, then 15 fathoms; we remained near the cape during the rest of the night; the north-wind made the thermometer descend to 19.7° (15.7° Reaum.) The next day I ascertained by chronometric observations, combined with the results of the *corrected* reckonings of the past night, that the breakers nearly at $16^{\circ} 50'$ of latitude, and $80^{\circ} 43' 49''$ long. The breaker on which the Spanish vessel *el Monarca* had nearly perished in 1798, is in lat. $16^{\circ} 44'$, and long. $80^{\circ} 23'$, consequently more to the east. While we traversed the bank of the Vibora, in the direction from S.S.E. to N.N.W., I repeatedly tried to measure the temperature of the water at the surface of the sea. The cooling was less sensible on the middle of the bank than on its edge, which we attributed to the currents that there mingle waters of different latitudes. On the south of Pedro Kays, the surface of the sea at 25 fathoms deep, was 26.4° ; and at 15 fathoms deep, 26.2° . The temperature of the sea on the east of the bank had been 26.8° . These experiments can only yield a precise result in those

latitudes, when made at a time when the wind does not blow from the north, and when the currents are less violent. The north-winds and the currents cool the water by degrees, even where the sea is very deep. On the south of cape Corrientes, lat. 20. 43', I found the sea at its surface 24.6°, and the air 19.8° cent. Some American pilots affirm, that among the Bahama Islands they can often guess, when seated in the cabin, that they are passing over sandbanks; they pretend that the lights are surrounded with small coloured halos, and that the air breathed is condensed in a visible manner. It may be permitted to doubt at least the latter fact; below 30° of latitude the cooling produced by the waters of the banks is not sufficiently considerable to cause this phenomenon. During the time we passed on the bank of the Vibora, the constitution of the air was quite different from what we found on quitting it. The rain was circumscribed by the limits of the bank, of which we could distinguish the form from afar, by the mass of vapors with which it was covered.

December 9th.—As we advanced towards the islands of the Caymans*, the north-east wind

* Christopher Columbus, in 1503, named the islands of the Caymans, *Penascales de las Tortugas*, on account of the sea-tortoises which he saw swimming in those latitudes (*Herera, Decad.*, i, p. 149).

again blew with the same violence. I obtained, notwithstanding the stormy weather, some heights of the sun, at the moment when we believed ourselves, though twelve miles distant, in the meridian of the center of the Great Cayman, which is covered with cocoa-trees. I have discussed in another place *, the position of the Great Cayman and the two islands on the east. Those points have long wandered on our hydrographic charts, and I fear that I have not been more fortunate than other observers, who flattered themselves they had made known its real position. The fine maps of the *Deposito de Madrid*, have, at different periods, marked the eastern cape of the Great Cayman, (in 1799-1804), long. $82^{\circ} 58'$; (in 1809), $83^{\circ} 40'$; (in 1821), again $82^{\circ} 59'$. The latter position, indicated on the map of M. Barcaiztegui, is identical with that on which I fixed; but it now appears certain, from the assertion of a very able navigator, Rear-Admiral Roussin, to whom we owe an excellent work on the coast of Brazil, that the western cape of Grand Cayman is in long. $83^{\circ} 45'$.

The weather continued bad, and the sea ex-

* *Obs. Astr., Int.*, p. xliii, Vol. ii, p. 114. *Espinosa, Memorias*, Vol. ii, p. 66. Purdy's map of the Antilles, rectified by Captain Andrew Livingston (1823), gives the cape on the S. W. $83^{\circ} 52'$; and on the N.E. $83^{\circ} 24'$.

tremely rough. The thermometer kept up between 19.2° - 20.3° (15.4° - 16.2° R.). At this low temperature the smell of the dried meat with which the vessel was laden, became still more insupportable. The sky displayed two beds of clouds, the lower was thick and pushed with extreme rapidity towards the S.E., the upper motionless, and divided at equal distance, in the form of feathered stripes. The wind at length was calmed on nearing cape Saint Antoine. I found the northern extremity of the cape $87^{\circ} 17' 22''$, or $2^{\circ} 34' 14''$ eastward of the Morro of the Havannah : this is the longitude now marked on the best maps. We were at the distance of three miles from land, but the proximity of the island of Cuba was announced by a delicious aromatic odour. The sailors pretend that this odour is not perceived when they approach from cape Catoche, on the barren coast of Mexico. As the weather grew clearer, the thermometer rose gradually in the shade to 27° : we advanced rapidly towards the north, pushed on by a current* from south-south-east, of which the temperature rose at the surface of the water, to 26.7° ; while out of

* Diego Columbus had very precise ideas on the existence and the direction of the Gulf-stream ; see *Petrus Martyr, Ocean*, Dec. 3. Lib. x, p. 326, 327, and *Herera*, Dec. 1, Lib. ix, p. 251.

the current, it was 24.6° . Fearing to go to the east of the Havannah, we at first wished to ascertain the islands of Tortoises (*Dry Tortugas*), situated at the south-west extremity of the peninsula of Florida; but the confidence which the making of the land at cape Saint Antoine had inspired for the chronometer of Louis Berthoud, rendered that precaution unnecessary. We anchored in the port of the Havannah, the 19th December, after twenty-five days of navigation in constantly bad weather.

The whole surface of the archipelago of the West Indies contains near 8300 square leagues (20 to a degree), of which the four great islands Cuba, Haiti, Jamaica, and Portorico occupy 7200, or near nine-tenths. The area of insular equinoxial America is consequently nearly equal to that of the Prussian monarchy, and twice as large as the *area* of the state of Pennsylvania. Its *relative population* differs little from that of the latter state, and is three times less than that of Scotland *. I have been occupied during several years in researches to ascertain the number of inhabitants of different castes and colours which a fatal developement of colonial industry has assembled in the West Indies. This problem is linked so nearly to the misfortunes of the African race, and the dan-

* See above, Vol. vi, p. 341.

gers to human civilization in the strange assemblage of so many various elements, that I would not confine myself to collecting what is found scattered in printed works. I consulted by an active correspondence the respectable and enlightened men, who took an interest in my labors, and rectified the first results I obtained. I testify with pleasure my warm gratitude to Lord Holland, Mr. Charles Ellis, Mr. Wilmot, under-secretary of state in the department of the colonies, Mr. Allen, General Macauley, Sir Charles Mac-Carthy, late governor of Sierra Leone, Sir James Mackintosh, Mr. Clarkson, Mr. David Hodgson, and Mr. James Cropper of Liverpool.

POPULATION OF THE WEST INDIES (AT THE CLOSE OF 1823.)

| Names of the Islands. | Total population. | Slaves. | Observations and Variations. |
|--------------------------------|-------------------|---------|---|
| I. ENGLISH WEST INDIA ISLANDS. | 776,500 | 626,800 | <p>The total population of the English West India islands was estimated in 1788, at 528,302, of which 454,161 were slaves.</p> <p>Bryan Edwards, in 1791: slaves, 455,624; whites, 65,305; free coloured population, 20,000. Colquhoun, in 1812: total 732,176; slaves, 634,096; free coloured population, 33,081; whites, 64,994. Melish: 673,070, of which 70,430 were whites, and 607,640 slaves. Persons belonging, in 1823, to the congregation of <i>methodists</i>, in the English islands, 23,127 blacks, and men of colour, and 8476 whites. (<i>Debates of May 15, 1823, p. 180.</i>)</p> |
| a) JAMAICA - - | 402,000 | 342,000 | <p>In 1734, slaves, 86,146; whites, 7644; in 1746, slaves, 112,428; whites, 10,000; in 1768, slaves, 176,914; whites, 17,947; in 1775, slaves, 190,914; whites, 18,500; in 1787, slaves, 250,000; whites, 28,000; in 1791, whites, 30,000; free men of colour, 10,000; slaves, 250,000; in 1800, slaves, 300,939; in 1810, slaves, 320,000; in 1812, slaves, 319,912; in 1815, slaves, 313,814; in 1816, slaves, 314,038; free, 45,000; in 1817, slaves, 345,252. (Ancient reports give for 1658, slaves, 1460; whites, 4500; for 1670, slaves, 8000; whites, 7500; for 1673, slaves, 9504.) From 1770 to 1786, 610,000 negro-slaves were imported to Jamaica, of whom one-fifth were re-exported to other islands; there remained therefore in the island 488,000. (<i>Bryan Edwards, Vol. ii, p. 64.</i>) From 1787 to 1808, 188,785 more were imported; altogether, in 108 years, 676,785 negroes; and yet there exists at Jamaica but the half of that number, less than 350,000. (<i>Hatchard, Review of Registry Laws, p. 74. Cropper, Letters to Mr. Wilberforce, 1822, p. 19, 29,</i></p> |

| Names of the Islands. | Total population. | Slaves. | Observations and Variations. |
|--|-------------------|---------|---|
| | | | <p>40.) Other estimates make the importation of the Africans to Jamaica since the conquest, amount to 850,000. (<i>East and West India sugar</i>, 1823. p. 34. <i>James Cropper, Relief for West Indian Distress</i>, 1823, p. 13. <i>Wilberforce, Appeal to Religion, Justice, and Humanity</i>, 1823, p. 49.) The population of the free men of colour is generally estimated too low. Mr. Stewart, who resided twenty years in that island (till 1820), supposes it to be 35,000, and the number of whites, 25,000. According to the <i>Official Registers</i>, which I owe to the obliging communication of Mr. Wilmot, in 1817; slaves, 343,145; in 1820, slaves, 341,812. In the last 14 years, on a slave population of 342,000, scarcely 600 marriages (257 a year) were legally contracted. (<i>Subst. of the Debate of the House of Commons</i>, 1823, p. 164.)</p> |
| b) BARBADOES - | 100,000 | 79,000 | <p>Mr. Morse estimates the total population in 1786 at 79,220; in 1805, slaves, 60,000; free men, 17,130; in 1811, according to a numeration believed to be very exact, slaves, 79,132; free coloured population, 2613; whites, 15,794. In 1823, probably 16,000 whites; free men of colour, of which the number augments greatly, 5000. Total population, perhaps 100,000. According to the <i>Official Registers</i>, in 1817, slaves, 77,493; in 1820, slaves, 78,345.</p> |
| c) ANTIGUA - | 40,000 | 31,000 | <p>In 1815, slaves, 36,000; free, 4000; in 1823, probably free-coloured population, 4000; whites, 5000. According to the <i>Official Registers</i> of 1817, slaves, 32,269; in 1820, slaves, 31,053.</p> |
| d) SAINT CHRISTOPHER, OR SAINT KITTs - - - | 23,000 | 19,500 | <p>In 1791, slaves, 20,435; whites, 1900; in 1805, slaves, 26,000; whites, 1800; free men of colour, perhaps 2500. Accord-</p> |

| Names of the Islands. | Total population. | Slaves. | Observations and Variations. |
|---|-------------------|---------|--|
| | | | ing to the <i>Official Registers</i> , slaves, 20,137 ; in 1820, slaves, 19,817. |
| e) NEVIS - - - | 11,000 | 9,500 | In 1809, total 9300, of whom 8000 were blacks (Chalmers) ; in 1812, total, 10,430, of whom 9326 were slaves. (<i>Offi. Reg.</i> of 1817 ; slaves, 9603 ; of 1820, slaves, 9261 ; free men of colour, nearly 1000 ; whites, 450. |
| f) GRENADA - - - | 29,000 | 25,000 | In 1791, according to Bryan Edwards, slaves, 23,926 ; whites, 1000 ; in 1815, slaves, 29,381 ; free, 1891. <i>Offi. Reg.</i> of 1817, slaves, 28,024 ; of 1820, slaves, 25,677 ; free men of colour, now, nearly 2800 ; whites, 900. |
| g) SAINT VINCENT AND THE GRENADINES - - - | 28,000 | 24,000 | In 1791, slaves, 11,853 ; whites, 1450 ; in 1812, total, 27,455, of whom 22,920 were slaves ; in 1815, total 23,493, among whom 2130 were free. <i>Offi. Reg.</i> of 1817, slaves, 25,255 ; of 1820, slaves, 24,252. |
| h) DOMINICA - - - | 20,000 | 16,000 | In 1791, slaves, 14,967 ; whites, 1236 ; in 1805, slaves, 22,083 ; free, 4416 ; in 1811, total, 25,031, of whom 1325 were whites ; free coloured population, 2988 ; slaves, 21,728. The relative number of the blacks or free mulattoes, and the whites, is here, as every where else, extremely uncertain ; the former are now perhaps the double of the latter in number. <i>Offi. Reg.</i> of 1817, slaves, 17,959 ; of 1820, slaves, 16,554. Slaves are often exported from Dominica and the Bahama islands to Demerara, where the climate causes a terrible mortality, even among the free coloured population, that are not inured to the climate. |
| i) MONTSERRAT - | 8,000 | 6,500 | In 1805, slaves, 9500 ; free, 1250 ; in 1812, slaves, 6534 ; free, 442. In 1823, |

| Names of the Islands. | Total population. | Slaves. | Observations and Variations. |
|--|-------------------|---------|--|
| k) ENGLISH VIRGIN ISLANDS, ANEGADA, VIRGIN GORDA AND TORTOLA | 8,500 | 6,000 | <p>according to the most correct opinions, 1500 free, of whom scarcely one-fifth are whites. <i>Offi. Reg.</i> 1817, slaves, 6610; of 1820, slaves, 6505. Mr. Morse estimates the total population in 1822, at 10,750; but it is not so great.</p> <p>Very uncertain. In 1820, probably, slaves, 6000; free men of colour, 1200-1500; whites, 400. In 1788, however, the slaves were estimated at 9000. (Melish reckoned in 1822, the total population at Tortola to be 10,500; and at Virgin Gorda, 8000!)</p> |
| l) TOBAGO - - - | 16,000 | 14,000 | <p>In 1805, slaves, 14,883; free, 1600; in 1811, slaves, 16,897; free, 935; in 1815, total, 18,000. <i>Offi. Reg.</i> of 1817, slaves, 15,470; of 1820, slaves, 14,581 [probably now 2000 free, of whom 1200 are coloured population.] Mr. Morse (<i>Modern Geogr.</i>, p. 236,) reckons for 1822, total 16,483, of whom 15,583 were slaves and free men of colour, and 900 whites.</p> |
| m) ANGUILLA AND BARBUDA - - | 2,500 | 1,800 | Uncertain. |
| n) TRINIDAD - - | 41,500 | 23,500 | <p>In 1805, slaves, 19,709; free, 5536 (Mr. Cullum). Numeration of 1811, believed to be very exact; total 32,989, of which 2617 were whites; free men of colour, 7493; free Indians, 1736; slaves, 21,143. <i>Offi. Reg.</i> of 1817, slaves, 25,941; in 1820, slaves, 23,537. It is usual to estimate much too low the constantly increasing population of this island. Mr. Morse, in 1822, total 28,477; yet there is no doubt of there being now at least 14,000 free men of colour; whites, 4000; slaves, nearly 24,000.</p> |
| o) SAINT LUCIE - | 17,000 | 13,000 | <p>In 1788, the total was estimated at 20,968, of whom 17,221 were slaves; in</p> |

| Names of the Islands. | Total population. | Slaves. | Observations and Variations. |
|-------------------------------|-------------------|---------|---|
| p) BAHAMA ISLANDS | 15,500 | 11,000 | <p>1810, total 17,485, of whom 14,397 were slaves; free men of colour, 1878; whites, 1210. <i>Offi. Reg.</i> of 1817, slaves, 15,893; of 1820, slaves, 13,050.</p> <p>Partly beyond the limits of the torrid zone. In 1810, total 16,718, of whom 11,146 were slaves. (Now probably 11,000 slaves; free coloured population, 2500-3000; whites, 1500.)</p> |
| q) BERMUDAN ISLANDS | 14,500 | 5,000 | <p>Small archipelago, situated in the temperate zone, and far distant from the rest of insular America. In 1791, total 10,780, of whom 4919 were slaves; in 1812, total 9900, of whom 4794 were slaves.</p> |
| II. HAITI, FRENCH AND SPANISH | 820,000 | | <p>Mr. Necker, in 1799, admitted in the <i>French part</i>, total 288,803; in 1788, total 520,000, of whom 40,000 were whites; freedmen, 28,000; slaves, 452,000; in 1802, Mr. Page estimated the total population at only 375,000, of whom 290,000 were labourers. In 1819, according to the observation of General Pamphile-Lacroix, the <i>French part</i> contained 501,000, of whom 480,000 were blacks, 20,000 mulattoes, and 1000 whites; <i>Spanish part</i>, 135,000, of whom 110,000 were blacks, and 25,000 whites. General Macaulay, whose researches always bear the character of philanthropy and the love of truth, thinks that the total population of Haiti exceeds 750,000, among whom, in the <i>French part</i>, 600,000 were negroes and mulattoes, and 4000 whites; in the <i>Spanish part</i>, 120,000 negroes and mulattoes, and 26,000 white creoles. In the <i>French part</i>, the number of mixed blood, 24,006. The last <i>official numeration</i> yields 935,335, among whom, in the circle of Jacmel only, 99,408; of Port au Prince,</p> |

| Names of the Islands. | Total population. | Slaves. | Observations and Variations. |
|-----------------------|-------------------|---------|--|
| | | | <p>89,164; of Cayes, 63,536; of Aguni, 58,587; of Leogane, 55,662; of Mirabalais, 53,649; of Nepper, 44,478; of the Cape Haitian, 38,566; of Tiburon, 37,927. of Jeremy, 37,652; of Saint Mark, 37,628; of the Great River, 35,372; of Gonaïves, 33,542; of Lembé, 33,475; of Marmelade, 32,852; of Santo Domingo, 20,076. (<i>New Monthly Mag.</i>, 1825, Feb., p. 69.) The precautions taken by the Haitian government to obtain a precise result, are not known. Having always in my labors on political economy, prescribed to myself the rule of publishing the lowest numbers, I have diminished one-ninth the result of the official numeration. The limit-numbers are now 800,000 and 940,000. Very exaggerated assertions, connected with political views, have carried the population of Haïti to more than a million; it is certain that this population augments with extreme rapidity, and is favored by wise institutions.</p> |
| II. SPANISH ISLANDS | 943,000 | 281,400 | <p>According to an official document presented to the Cortes at Madrid, in 1821, total 630,980, of whom 290,021 were whites; free coloured population, 115,691; slaves, 225,268. <i>Reclamacion hecha por los representantes de la Isla de Cuba, contra los aranceles</i>, p. 7. The number of slaves imported, from 1817-1819, was from 15,000 to 26,000. <i>Letters from the Havannah to John Wilson Croker, Esq.</i>, 1821, p. 18-36. These importations are frightful; even Rio Janeiro does not receive a greater number in these latter times; namely, 1821, slaves, 20,852; in 1822, slaves, 17,008; in 1823, slaves, 20,610; <i>Offic. Correspond. with the Brit. Commis.</i>, 1823, B., p. 109, 121. <i>Alexander Caldcleugh's Travels in South America</i>, 1825, Vol. ii, p. 266. (Mr. Melish, in his <i>American Geography</i>, gives the island of</p> |
| a) CUBA - - - | 700,000 | 256,000 | |

| Names of the Islands. | Total population. | Slaves. | Observations and Variations. |
|--|-------------------|---------|---|
| | | | Cuba, in 1823, a population of only 435,000.) |
| b) PORTORICO | 225,000 | 25,000 | The total population in 1778, was estimated at 80,650; in 1794, at 136,000, of whom 15,000 were whites, 103,500 free men of colour, and 17,500 slaves. But the official numeration of 1822, gives with more certainty, for the total population 225,000, of whom 25,000 were slaves. (<i>Poinsett, Notes on Mexico; Philad.</i> 1824, p. 5). If the number of whites amounted only to 22,000, this numeration would yield 178,000 for free men of colour, an estimate which appears to me exaggerated when compared with the free men of colour of the whole island of Cuba. |
| c) MARGUERITA | 18,000 | 400 | M. de Ponce : 14,000, of whom 2000 were Indians. |
| IV. FRENCH ISLANDS | 219,000 | 178,000 | Freedmen, probably more than 25,000. |
| a) GUADALOUPE & ITS DEPENDENCIES. (SAINT MARIE- GALANTE LA DESIRADE, & PART OF ST. MARTIN) | 120,000 | 100,000 | In 1788, total 101,971, of whom 13,466 were whites; 3044 free men of colour; 85,461 slaves. From the official information, which I owe to Mr. Moreau de Jonnès, total in 1822, 120,000, of whom 13,000 were whites; free coloured population, 7000; slaves, 100,000. Other official documents give at Guadeloupe in 1821, total 109,404, of whom 12,802 were whites; free men of colour, 8604; slaves, 87,998. |
| b) MARTINIQUE | 99,000 | 78,000 | The total population in 1815, was believed to be 94,413, of whom 9206 were whites, 8630 men of colour, and 76,577 blacks. According to the official numeration of 1822, total 98,125, of whom 9660 were whites, 10,173 men of colour, and 76,914 slaves. |

| Names of the Islands, | Total population. | Slaves. | Observations and Variations. |
|--|-------------------|---------|--|
| V. DUTCH, DANISH, AND SWEDISH ISLANDS - - - | 84,500 | 61,300 | |
| a) SAINT EUSTACHE AND SABA - - | 18,000 | 12,000 | No island presents greater uncertainty. M. Malte Brun (<i>Geogr.</i> Vol. v, p. 748) estimates the total population in 1815, at only 6400, of whom 5000 were whites, 600 free coloured men, and 800 slaves. But this number of whites is little probable. M. J. Van den Bosch (<i>Neder landsehe Overzeesche Bezittingen</i> , 1818, Vol. ii, p. 232) fixes on 2400; while the new Geography of Mr. Morse, in general carefully executed (<i>New System of Modern Geography</i> , 1822, p. 249), has fixed on 20,000. |
| b) SAINT MARTIN | 6,000 | 4,000 | Morse, <i>l. c.</i> , p. 248. One part is French, the other Dutch. |
| c) CURAÇOA - - | 11,000 | 6,500 | Melish, 8500; Hassel, 14,000. Van den Bosch (Vol. ii, p. 227) for 1805, total population, 12,840. Dutch islands in general, 35,000, of whom 22,500 are slaves. |
| d) SAINT CROIX - | 32,000 | 27,000 | In 1805, whites, 2223; freedmen, 1664; slaves, 25,452. Total, 29,339. |
| e) SAINT THOMAS | 7,000 | 5,500 | In 1815, whites, 726; freedmen, 239; slaves, 4769. Total, 5734. |
| f) SAINT JOHN - | 2,500 | 2,300 | In 1815, total, 2120, of whom, whites, 102; slaves, 1292. Mr. Hassel estimates the total population of the Danish islands, in 1805, at 38,695; Mr. Colquhoun estimates it in 1812, at 42,787, of whom 37,030 were slaves. |
| g) SAINT BARTHOLOMEW - - - | 8,000 | 4,000 | Morse, p. 249. |

The observations placed against the results which are now the most probable, contain some historical facts on the increasing progression of the population. These facts, of very unequal precision, are, however, only *variantes lectiones*, the expression of the opinion formed at particular periods, on the number of the inhabitants. Most frequently, they are not those differences, but the official registers of the last years, which have served for the basis of my calculations. When *registers* are wanting, we can only be guided by general considerations on the value of statistic results. In opinions which are contested with violence, and which affect the greatest interests of humanity, we must distrust the exaggeration of extreme parties, and take the mean between the estimates furnished by the planters, and those of associations formed with the view of diminishing the miseries of slavery. The comparison of the registers of different periods does not always furnish precise ideas of the mortality of the slaves in the colonies of different nations. There are countries in which the names of deceased slaves are given to those who are clandestinely introduced. When certain results cannot be obtained, much is gained by finding the *limit-numbers*; and being able to assert, that in the island of Jamaica, there are at least 342,000 slaves; at Barbadoes, 79,000, and at Guadaloupe, 100,000. The re-

sults furnished by the enumerating or registering of the slaves (*Slave Registry Returns*), afford only *limit-numbers*, the *minima* of particular periods. The proprietors have an interest in concealing a part of the slaves they possess ; the effects of emancipation * are confounded on the registers with those of decease ; and on the other hand a part of the births is hidden. The registers in general tend to prove, that hitherto (from 1817 to 1824) the black population decreases in the English colonies of the West Indies, and much more in the small islands than at Jamaica, and wherever the planters work with considerable capitals a soil producing alimentary subsistence in abundance. The official registers give for twelve English West India islands, in 1817, 617,799 slaves ; for 1822, 604,444 slaves ; from whence results a loss of 1-46th in three years. At Jamaica alone it was only 1-257th ; and in the small islands it fluctuates from 1-12th to 1-60th. I do not give these statements as true, but as resulting from the *registers*. The distinction of whites, and free coloured population, presents such great difficulties, that at the end of the year 1823,

* *Adam Hodgson, Letter to M. Say, 1823, p. 37. Debate of the 15th May, 1823, p. 184. Bridges on Manumission and Negro Slavery of the United States and Jamaica, 1823, pp. 51 and 85.*

the Colonial Office was in possession of no precise information on that important point. But the English government has recently, with the most laudable purpose, employed means fitted to solve this problem, connected more than any other with the ideas of public security. The free negroes at the Havanah, form 5-13ths, or 38 per cent; but their number in general can only be estimated at 2-5ths. The estimate of free men is not less uncertain in some colonies than that of slaves. There are some individuals who enjoy full liberty, but a liberty not legally recognized.

In the registers that indicate the population of the islands, the words *blacks* and *slaves* are generally taken for synonymous. There exists, however, among the slaves, a small number of mulattoes, and others of mixed race. I believe their number amounts at most to 1-20th; and I calculated according to this supposition, the number of the negro slaves in the table of the black population of America. The numeration of the island of Cuba furnishes a more considerable result; that of 1-10th to 1-12th in the town of Havannah. It possessed in 1810, on a slave population of 28,700, *pardos esclavos*, 2300; *morenos esclavos*, 26,400. The great towns in the Spanish islands are characterized by this accumulation of mulattoes and slaves of mixed race.

With respect to the population of the island of Saint Domingo (Haiti) I believe I have fixed on an estimate sufficiently low. We possess partial statements of the official numeration, circle by circle; and considerations founded on positive calculations lead us to conclude that the population of Haiti may now attain 820,000. Mr. Pagé, after the calamities of the colony in 1802, estimated both parts, French and Spanish, at 500,000. Now, supposing r or the rate of annual increase to be only 0.016 (which doubles in forty-four years), I find for 1822, a population of 686,800. If we admit a more rapid increase, similar to that of the slave population in the southern part of the United States ($r=0.026$, consequently a doubling in 27 years) we obtain for 1822 a population of 835,500; but how can it be believed that Mr. Pagé has not estimated the population of 1802 too low? Necker admitted in 1788, 520,000 in the French part, and 620,000 in the whole island of Saint Domingo. Many years of peace and tranquillity have succeeded that period, interrupted by some of disorder and carnage. Even the maroon-negroes of Jamaica have augmented, deducting from the number the fugitive slaves who join them occasionally. It is more natural to admit that, in an interval of fourteen years (from 1788 to 1802,) the population has been preserved at 600,000, notwithstanding the civil

wars and emigration; and, admitting this statement, we find, according to the two hypotheses ($r = 0,016$, or $r = 0,026$), 824,200, or 1,002,500. The last official numeration, published by the government of Haïti, gives 935,300: in order to avoid exaggeration, I fixed on 820,000.

BLACK POPULATION OF CONTINENTAL AND INSULARY AMERICA.

1. *Negro Slaves.*

| | |
|--------------------------------------|-----------|
| West India insulary America..... | 1,090,000 |
| United States | 1,650,000 |
| Brazil | 1,800,000 |
| Spanish Colonies of the Continent .. | 307,000 |
| English, Dutch and French Guyanas | 200,000 |
| | <hr/> |
| | 5,047,000 |

2. *Free Negroes.*

| | |
|--------------------------------------|-----------|
| Haïti, and the other Islands | 870,000 |
| United States | 270,000 |
| Brazil, perhaps | 160,000 |
| Spanish Colonies on the Continent... | 80,000 |
| English, Dutch, and French Guyanas.. | 6,000 |
| | <hr/> |
| | 1,386,000 |

RECAPITULATION.

Blacks without mixture, consequently excluding mulattoes:

| | |
|-----------------------|--------------|
| 5,047,000 slaves..... | 79 per cent. |
| 1,386,000 free..... | 21 |
| <hr/> | |
| 6,433,000 | |

The habit of living in countries where the whites are so numerous as in the United States, has had a singular influence on the ideas which have been formed of the preponderance of different races in various parts of the New Continent. The number of negroes and of mixed race, which amount together, in my tables, to more than 12,861,000, or to 37 per cent., has been arbitrarily diminished ; while the white population does not exceed $13\frac{1}{2}$ millions, or 33 per cent. Mr. Morse admitted for the whole of America, in 1822, 50-100th whites, 33-100th Indians, 11-100th negroes, and 5-100ths of mixed race. MM. Carry and Lea suppose a population of 2,050,000 in the archipelago of the West Indies, of which 450,000 whites, and 1,600,000 blacks and mulattoes ; this indicates 22 per cent. of whites. We have just seen that the statement is still a little more unfavourable, and that on the total population of the West Indies, 2,843,000, there are 17 per cent. of whites, and 83 per cent. of men of colour, slaves and free ; that is, that the whites are to the men of colour = 1 : 5.

| DIVISIONS. | TOTAL POPULATION. | BLACK SLAVES, and some Mulattoes. | FREE MEN of colour, Mulat- toes, & Blacks. | WHITES. |
|------------------------------------|----------------------|---|--|-----------------------|
| Spanish West Indies | 943,000 | 281,400 | 319,500 | 342,100 |
| Haïti | 820,000 | ..... | 790,000 | 30,000 |
| English Islands..... | 776,500 | 626,800 | 78,350 | 71,350 |
| French Islands | 219,000 | 178,000 | 18,000 | 23,000 |
| Dutch, Danish, and Swedish Islands | 84,500 | 61,300 | 7,050 | 16,150 |
| Total of the West Indies | 2,843,000 | 1,147,500 (40 p. c.) | 1,212,900 (43 p. c.) | 482,600 (17 p. c.) |

DISTRIBUTION OF THE RACES IN SPANISH AMERICA.

1. *Natives.* (Indians, red men ; copper-coloured American, or primitive race, without mixture of white, and negro.)

| | |
|---|-----------|
| Mexico | 3,700,000 |
| Guatemala | 880,000 |
| Columbia | 720,000 |
| Peru and Chili | 1,030,000 |
| Buenos Ayres, with the Pro- vinces of Sierra | 1,200,000 |
| | <hr/> |
| | 7,530,000 |

2. *Whites.* (Europeans, and descendants of Europeans, without mixture of Negro and Indian, the pretended race of Caucasus.)

| | |
|------------------------------|-----------|
| Mexico | 1,230,000 |
| Guatemala | 280,000 |
| Cuba and Portorico | 339,000 |
| Columbia | 642,000 |
| Peru and Chili | 465,000 |
| Buenos Ayres | 320,000 |
| | <hr/> |
| | 3,276,000 |

3. *Negroes.* (African race, without mixture of white or Indian, blacks, free and slaves.)

| | |
|------------------------------|---------|
| Cuba and Portorico | 389,000 |
| Continent | 387,000 |
| | <hr/> |
| | 776,000 |

4. *Black, white, and Indian mixed races.* (Mulattoes, Mes-
tizos, Zambos, and mixture of mixtures.)

| | |
|--------------------------|-----------|
| Mexico..... | 1,860,000 |
| Guatemala | 420,000 |
| Columbia | 1,256,000 |
| Peru and Chili | 853,000 |
| Buenos Ayres | 742,000 |
| Cuba and Portorico..... | 197,000 |
| | <hr/> |
| | 5,328,000 |

RECAPITULATION,

ACCORDING TO THE PREPONDERANCE OF THE RACES.

| | | |
|----------------------|------------|-----------------|
| Indians..... | 7,530,000 | or 45 per cent. |
| Mixed races..... | 5,328,000 | 32 |
| Whites..... | 3,276,000 | 19 |
| Blacks, African race | 776,000 | 4 |
| | <hr/> | |
| | 16,910,000 | |

DISTRIBUTION OF THE RACES IN CONTINENTAL AND
INSULARY AMERICA.

1. *Whites.*

| | |
|---|------------|
| Spanish America..... | 3,276,000 |
| West Indies, without Cuba, Portorico, and Marguerita | 140,000 |
| Brazil | 920,000 |
| United States | 8,575,000 |
| Canada | 550,000 |
| English, Dutch, and French Guyanas | 10,000 |
| | <hr/> |
| | 13,471,000 |

2. *Indians.*

| | |
|---|-----------|
| Spanish America | 7,530,000 |
| Brazil (inclosed Indians of Rio Negro, Rio Branco, and the Amazon) | 260,000 |
| Independent Indians, on the east and west of the Rocky Mountains, on the frontiers of New Mexico, the Mosquitos, &c. | 400,000 |
| Independent Indians of South America | 420,000 |
| | <hr/> |
| | 8,610,000 |

3. *Negroes.*

| | |
|--|-----------|
| West Indies, with Cuba and Portorico | 1,960,000 |
| Continent of Spanish America..... .. | 387,000 |
| Brazil | 1,960,000 |
| English, Dutch, and French Guyanas..... | 206,000 |
| United States | 1,920,000 |
| | <hr/> |
| | 6,433,000 |

4. *Mixed races.*

| | |
|--|-----------|
| Spanish America | 5,328,000 |
| West Indies, without Cuba, Portorico, and Marguerita | 190,000 |
| Brazil and the United States | 890,000 |
| English, Dutch, and French Guyanas | 20,000 |
| | <hr/> |
| | 6,428,000 |

RECAPITULATION.

| | | |
|------------------|------------|-----------------|
| Whites..... | 13,471,000 | or 38 per cent. |
| Indians..... | 8,610,000 | 25 |
| Negroes | 6,433,000 | 19 |
| Mixed race | 6,428,000 | 18 |
| | <hr/> | |
| | 34,942,000 | |

A calculation founded on the numeration of 1810 and 1820, gives (the rate of the increase = 0,02611) at the end of 1822, at least 1,623,000 slaves in the United States (See above, pp. 140, and 369, and *Sixteenth Report of the African Institution*, p. 324); and at the end of 1824, at least 1,708,300. The free men of colour were, in 1820, more than 238,000. In the two colonies of Demerara and Essequibo, 71,180 slaves were computed in 1811; free men of colour, 2980; whites 2871; total 77,131. Total population at Berbice, 25,959, of which 550 whites, 240 free men of colour, and 25,169 negro slaves. Total population of Demerara, Essequibo, and Berbice for 1811, above 103,000, of which more than 96,000 slaves. According to J. Van den Bosch (Vol. ii, p. 114), there were at Demerara in 1814, 47,132 slaves; at Essequibo, 16,187; and at Berbice, 22,223; total 85,442 slaves. General Macaulay believed the population of Demerara to be in 1823, 83,900, of which 77,400 slaves, 3000 free men of colour, and 3500 whites. He admitted for Berbice, 25,430, of whom 23,180 slaves, 1500 free men of colour, and 750 whites. The *official registers* communicated by Mr. Wilmot, give for the colony of Demerara in 1817, 77,867 slaves; in 1820, 77,376; the colony of Berbice in 1817, slaves 23,725; and in 1820, 23,180 slaves. It appears probable that the English, Dutch, and French Guyanas now contain more than 236,000 slaves. French Guyana reckoned in 1821, a total of 16,000, without Indians; namely, 12,000 slaves, 1000 whites, and 3000 free men of colour. According to the official documents, it contained (1st January 1824) 1035 whites, 1923 free men of colour, 701 Indians, and 13,656 slaves; total 17,315. The number of blacks spread over the vast continent of Spanish America, is so small (below 390,000), that, happily, they do not form $2\frac{1}{2}$ per cent of the continental population. Salutary changes are preparing in the condition of the slaves. According to the laws that govern the new independent

states, slavery will be extinguished by degrees : the republic of Columbia has given the example of progressive liberation. That measure, at once humane and prudent, is due to the disinterestedness of General Bolivar, whose name is not less illustrious by the virtues of the citizen, and by his moderation in success, than by the splendour of his military glory.

DISTRIBUTION OF THE TOTAL POPULATION OF AMERICA, ACCORDING TO THE DIVERSITY OF RELIGIOUS WORSHIP.

| | |
|---|------------|
| I. <i>Roman Catholics</i> | 22,486,000 |
| <i>a</i> Continental Spanish America ... | 15,985,000 |
| Whites | 2,937,000 |
| Indians | 7,530,000 |
| Mixed & negro race | 5,518,000 |
| | <hr/> |
| | 15,985,000 |
| <i>b</i> Portuguese America | 4,000,000 |
| <i>c</i> United States, Lower Canada, | |
| and French Guyana | 537,000 |
| <i>d</i> Haïti, Cuba, Portorico, and | |
| French West Indies | 1,964,000 |
| | <hr/> |
| | 22,486,000 |
| II. <i>Protestants</i> | 11,636,000 |
| <i>a</i> United States | 10,295,000 |
| <i>b</i> English Canada, New Scotland, | |
| Labrador | 260,000 |
| <i>c</i> English and Dutch Guyana..... | 220,000 |
| <i>d</i> English West India Islands ... | 777,000 |
| <i>e</i> Dutch and Danish Islands, &c. | 84,000 |
| | <hr/> |
| | 11,636,000 |
| III. <i>Independent Indians, not Christians</i> | 820,000 |
| | <hr/> |
| | 34,942,000 |

This statement furnishes only the great divisions of the Christian communities. I believe that the materials I possess* on the relative state of the Roman Catholics and Protestants are sufficiently exact, but I shall not enter into the detail of the divisions of the protestant or evangelical [Calvinistic] church. A few partial estimates, for instance, of the number of catholics in Louisiana, Maryland, and Lower Canada, are perhaps somewhat uncertain ; but that uncertainty affects quantities which have but a feeble influence on the definitive result. I believe that the number of protestants in the whole of continental and insular America, from the southern extremity of Chili to Greenland, is, to the Roman Catholics, as 1 : 2. There exist, on the western coast of North America, some thousands of individuals who follow the Greek worship. I am ignorant of the number of Jews spread over the surface of the United States, and in several of the West India islands ; but their number is inconsiderable. The independent Indians, who belong to no Christian community, are to the Christian population as 1 : 42. In the present state of

* These materials first appeared in the *Revue Protestante*, No. 3, p. 97. (See my Letter to Mr. Charles Coquerel.) More precise notions on the population of Cuba, Haïti, and Portorico, have led to some corrections in the partial statements.

things, the Protestant population augments much more rapidly in the New World than the catholic ; and it is probable that, notwithstanding the state of prosperity to which independence, the progress of reason, and free institutions will raise Spanish America, Brazil, and the island of Haiti, the relation of 1 to 2 will, in less than half a century, be considerably modified in favour of protestant communities. Admitting a total population in Europe of 198 millions, we may compute nearly 103 millions of Roman Catholics, 38 millions who follow the Greek worship, 52 millions of Protestants, and 5 millions of Mahometans. The numerical relation of the Protestants to the members of the Roman Catholic and Greek churches, is consequently, by approximation, as $1 : 2\frac{7}{10}$. This relation between the Protestants and Roman Catholics is the same in Europe and in America. The tables we collect at the end of this chapter, have a close connexion with each other ; for in every zone, the difference of race and origin, the individuality of language, and the state of domestic liberty, have a powerful influence on the dispositions of men for particular forms of worship.

**PREPONDERANCE OF THE LANGUAGES IN THE NEW
CONTINENT.**

1. *English language.*

| | |
|---|------------|
| United States..... | 10,525,000 |
| Upper Canada, New Scotland, New Brunswick | 260,000 |
| West Indies, and English Guyana | 862,000 |
| | <hr/> |
| | 11,647,000 |

2. *Spanish language.*

| | |
|-----------------------------|------------|
| Spanish America, namely, | |
| Whites | 3,276,000 |
| Indians | 1,000,000 |
| Mixed and negro race | 6,104,000 |
| Spanish part of Haïti | 124,000 |
| | <hr/> |
| | 10,504,000 |

3. *Indian tongues.*

| | |
|--|-----------|
| Spanish and Portuguese America, comprehending the independent tribes | 7,593,000 |
|--|-----------|

4. *Portuguese language.*

| | |
|--------------|-----------|
| Brazil | 3,740,000 |
|--------------|-----------|

5. *French language.*

| | |
|---|-----------|
| Haïti | 696,000 |
| Islands dependent on France, Louisiana, and French Guyana | 256,000 |
| Lower Canada, and some tribes of independent Indians | 290,000 |
| | <hr/> |
| | 1,242,000 |

6. *Dutch, Danish, Swedish and Russian languages.*

| | |
|----------------------------------|---------|
| West Indies | 84,000 |
| Guyana | 117,000 |
| Russia, on the N. W. coast | 15,000 |
| | <hr/> |
| | 216,000 |

RECAPITULATION.

| | |
|---------------------------------|------------|
| English language | 11,647,000 |
| Spanish | 16,504,000 |
| Indian | 7,593,000 |
| Portuguese..... | 3,740,000 |
| French | 1,242,900 |
| Dutch, Danish and Swedish | 216,000 |
| | <hr/> |
| | 34,942,000 |

| | |
|---------------------------------|------------|
| Languages of Latin Europe | 15,486,000 |
| Languages of Germanic root..... | 11,863,000 |

| | |
|--------------------------|------------|
| European languages | 27,349,000 |
| Indian languages | 7,593,000 |

I have not mentioned separately the German, the Gaelic (Irish) and the Basque, because the numerous individuals who preserve the knowledge of those mother-tongues, understand also English or the Castillian. The number of individuals who usually speak the Indian languages, is at present as $1 : 3\frac{2}{5}$ to the number who employ the languages of Europe. By the more rapid increase of the population of the United States, the languages of the German

branch will gain insensibly in the numerical relation over the languages of Latin Europe ; but the latter will spread at the same time, by the effect of the increasing civilization of the nations of Spanish and Portuguese race in the Indian villages, where scarcely a twentieth part of the population understand a few Castilian and Portuguese words. I believe there still exist more than seven millions and a half of natives in America, who have preserved the use of their own language, and are almost entirely ignorant of the European idioms. Such is also the opinion of the Archbishop of Mexico, and of several ecclesiastics alike respectable, who long inhabited Upper Peru, and whom I was enabled to consult on this subject. The small number of Indians (perhaps a million) who have entirely forgotten their native languages, inhabit large towns, or very populous villages in their vicinity. Among the individuals who speak French in the New Continent, we find more than 700,000 negroes of African race, a circumstance which, notwithstanding the laudable efforts of the Haitian government for popular instruction, does not contribute to maintain the purity of the language. We may admit in general, that in continental and insular America, there are, in 6,433,000 blacks, more than 25-100ths who speak English, more than 30-100ths who speak Portu-

guese, and more than 14-100ths and 12-100ths who speak French and Spanish.

These statements of population, considered in their relations with the differences of race, languages, and worship, are composed of very variable elements, and represent approximately the state of American society. In a work of this kind, we can take into consideration only great masses ; the partial estimates may in time acquire more rigorous precision. The language of cyphers, the sole hieroglyphics which have been preserved among the signs of thought, stands in no need of interpretation. There is something serious and prophetic in these inventories of the human race : in them the whole future destiny of the New World seems to be inscribed.

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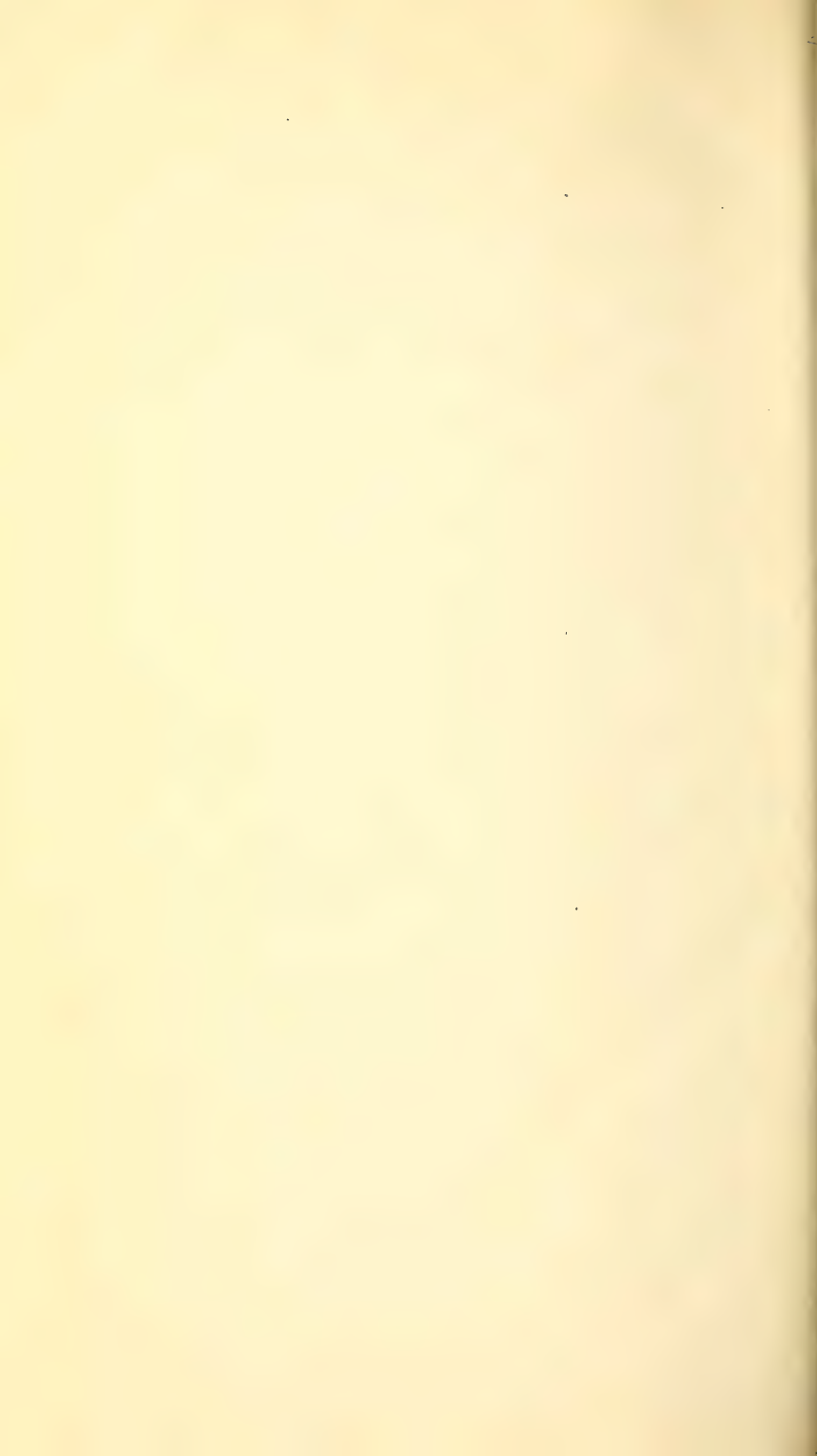
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